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BULLETIN

OF

MISCELLANEOUS INFORMATION.

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DCLVI.—A REVISION OF THE GENUS TILLETIA.

(*With Plate.*)

GEO. MASSEE.

All species included in the genus, as at present defined, are endophytic obligate parasites, and out of a total of twenty-six species, all are parasitic on plants belonging to the Gramineæ, with the exception of *Tilletia arctica*, Rostr., and *T. Sphagni*, Nawaschin. The former of these is parasitic on *Carex festiva*, Dewey, and the latter in the capsules of *Sphagnum squarrosum*, Pers. The infested capsules are somewhat dwarfed, and formed what were known as microsporangia by bryologists, while the fungus spores they contained were called microspores.

In the Uredineæ what may be termed biological species have been proved to exist; that is to say, of a species one or more forms not morphologically distinct may exist, that are distinguishable only by the fact that they are confined to one particular host-plant.

Professor Eriksson, our best authority on grain-rusts, has the following remarks* on this phase of the subject:—"Between certain of these forms which constitute a species, for instance, the three forms of black rust—*Puccinia graminis*, Pers.—we have not succeeded in discovering, even with the aid of a microscope, any distinguishing difference, such as the size, colour, and distribution of the pustules, the shape and size of the spores, &c. However, there is a difference between them with regard to their inner nature that is of no little practical interest. The difference appears in that every form is almost exclusively confined to its particular cereal, and that consequently it is able to infect no cereal but that one."

* Eriksson in Bot. Gaz. xxv. (1898), p. 29.

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In the genus *Tilletia* the existence of such biological forms has not been demonstrated, but the species enumerated in the following pages are founded on morphological characters.

Examination of a large amount of material has led to the conclusion that the host-plant is absolutely worthless as a factor in the discrimination of morphologically defined species. For this reason the species as here understood, do not coincide with those of many previous workers, where the host was an important, and not infrequently the only feature relied upon for distinguishing between presumedly distinct but allied species.

With regard to geographical distribution, the genus is very widely distributed, whereas the species are restricted in their range, each being confined to a portion of one Continent, with the exception of those species that are parasitic on cultivated cereals, the explanation of which is obvious. Of these *Tilletia Caries* occurs in Europe, Africa, Australia, United States, South America; *T. levis* in Europe, Australia, United States; *T. Hordei* in Europe, Asia, Africa.

The following table shows the distribution of the species :—

Europe, 13 species.—*lævis*, *de Baryana*, *arctica*, *Lolii*, *controversa*, *separata*, *Caries*, *Rauwenhoffii*, *Hordei*, *endophylla*, *Sesleriæ*, *Berkeleyi*, *Sphagni*, (*Fischeri* ?).
Asia, 2 species.—*controversa*, *Hordei*, (*Vulpiæ* ?).
Africa, 3 species.—*verrucosa*, *Caries*, *Hordei*.
Mauritius, 1 species.—*Ayresii*.
Australia, 4 species.—*lævis*, *mixta*, *epiphylla*, *Caries*.
United States, 9 species.—*lævis*, *rotundata*, *mixta*, *rugispora*, *cerebrina*, *buchloeana*, *Caries*, *Elymi*, *fusca*.
Antilles, 1 species.—*magnusiana*.
South America, 3 species.—*hyalospora*, *Caries*, *zonata*.

TILLÆTIA, Tulasne in Ann. Sci. Nat., sér. 3, vol. vii., p. 112 (1847); Sacc., Syll. vii. (1888), p. 481.

Endophytic obligate parasites. Spore-mass pulverulent, black or blackish-olive at maturity, often fœtid, especially when moistened. Spores free, produced singly at the tips of somewhat gelatinous, swollen, fertile hyphæ, at first covered by the epidermis of the host, forming a blackish powdery mass at maturity. On germination, the spore gives origin to a promycelium, which bears a terminal whorl of slender, elongated secondary-spores at its apex. Secondary-spores usually conjugating in pairs, and on germination producing slender, elongated conidia.—*Ustilago*, Link, in Berl. Mag. der Gesellsch. der Nat. Freunde, iii. (1809); Lév., in Ann. Sci. Nat., sér. 2, xi. (1839), 116.

Tulasne separated the species included under *Tilletia*, from the heterogeneous assemblage of species previously included under *Ustilago*, *Uredo*, *Erysibe*, &c., of old authors, taking as his principal generic character, the peculiar mode of germination and production of secondary-spores as observed in *Tilletia Caries* (*T. Tritici*, Winter).

The principal distinctive features of *Tilletia*, as defined by the systematist are :—spores free (not aggregated in groups), forming

a dry pulverulent mass at maturity, and producing on germination a whorl or cluster of secondary-spores at the apex of the promycelium.

Entyloma agrees in the free spores, and in the mode of production of the secondary-spores, but differs in the spore-mass not being pulverulent at maturity.

Urocystis agrees with *Tilletia* in the spore-mass being dry and pulverulent when mature, also in the method of germination and formation of secondary-spores, but differs in the spores being produced in groups, the central ones of the group being fertile, the peripheral ones sterile.

The mode of spore-germination is up to the present unknown in more than half the accepted species, their claim to a position in the genus depending on the two remaining features indicated above—spores free, forming a pulverulent mass at maturity; now these characters are also common to the genus *Ustilago*, and the means of distinguishing between the two genera in the absence of evidence afforded by germination, and absence of knowledge as to the origin of the spores, turns on the relatively much larger spores in *Tilletia*, which (with one exception, *T. lævis*) have the epispore reticulated or warted.

Neovossia was originally separated from *Tilletia* on some slight difference in the structure of the epispore. It has recently been studied by Brefeld, and although the spore-structure does not indicate a generic distinction, this author retains the genus as valid; the distinction from *Tilletia* advanced being a negative character—the secondary spores are produced in a tuft at the apex of the promycelium, as in *Tilletia*, but do not conjugate in pairs as in the last-named genus. This attitude is somewhat surprising, remembering that Brefeld does not admit of any sexual significance in a junction by a transverse band of adjoining pairs of secondary-spores.

Key to the species.

Series A. Epispore smooth	1. *T. lævis.*
Series B. Epispore warted or echinulate.	
Spores produced in the ovary.	
Spores 20–25 μ; epispore with acute pyramidal warts ...	2. *T. verrucosa.*
Spores 20–25 μ; epispore densely covered with minute warts	3. *T. rotundata.*
Spores deep chestnut-brown under the microscope, 16–18 μ; epispore very minutely warted	4. *T. mixta.*
Spores straw-coloured under the microscope, 13–16 μ; epispore very minutely warted	5. *T. Ayresii.*
Spores yellow-brown under the microscope, 12–15 μ; epispore densely and minutely warted	6. *T. magnusiana*
Spores 16–22 μ, densely covered with minute, irregular, flat-topped, dark coloured warts, formed by the breaking up of the epispore, interstices paler	7. *T. rugispora.*
Spores produced in leaves and culm.	
Spores 10–18 μ, densely covered with minute, dark, flat-topped warts formed by the breaking up of the epispore, interstices paler	8. *T. de Baryana.*
Spores blackish-brown under the microscope; epispore minutely papillose	9. *T. arctica.*
Spores 35–38 μ; epispore with scattered exceedingly minute warts	10. *T. epiphylla.*

Series C. Epispore reticulated.
Spores produced in the ovary.
Spores sub-hyaline or very pale brown under the microscope.
Spores 20-24 μ, almost colourless; epispore with sub-concentric ribs united by transverse bars ... ... 11. *T. hyalospora.*
Spores 23–26 μ, pallid; epispore with a shallow, small-meshed network ... ... 12. *T. Lolii.*
Spores 18–25 μ, pale brown; epispore with a shallow, large-meshed network... ... ... 13. *T. controversa.*
Spores dark brown under the microscope.
Ridges on the epispore with numerous free ends, or more or less formed of coalesced warts.
Spores 23–28 μ; epispore with ridges forming a reticulation, but having many free ends... ... 14. *T. cerebrina.*
Spores 16–21 μ; ridges of the epispore forming the reticulation mainly formed of confluent warts or spines ... ... 15. *T. buchloeana.*
Reticulation of the epispore formed of plates or ridges without free ends.
Spore-mass foetid.
Spores 20-27 μ; network of epispore, large-meshed 16. *T. separata.*
Spores 17–22 μ; network of epispore, small-meshed 17. *T. Caries.*
Spore-mass not foetid.
Spores 24–28 μ, dark olive-brown; reticulation of epispore shallow and small-meshed ... ... 18. *T. Elymi.*
Spores dark brown, averaging 33 μ; ridges of epispore 4 μ high; meshes polygonal, large ... 19. *T. inolens.*
Spores 25–30 μ, olive-brown; reticulation of epispore rather deep, large-meshed ... ... 20. *T. Rauwenhoffii.*
Spores 16–25 μ, dark brown; reticulation of epispore large-meshed, mesh very irregular in form ... 21. *T. fusca.*
Spores 19–20 μ, brown; reticulation of epispore small meshed ... ... 22. *T. Hordei.*
Spores 15–18 μ, brown; reticulation of epispore small-meshed ... ... 23. *T. zonata.*
Spores produced on the leaves or culm.
Spores 18–25 μ, brown, border similarly coloured; reticulation of the epispore small meshed... ... ... 24. *T. endophylla.*
Spores 25–28 μ, dark brown; reticulation of epispore shallow and small-meshed ... ... 25. *T. Sesleriæ.*
Spores 15–18 μ; reticulation of epispore very small-meshed 26. *T. Berkeleyi.*
Spores produced in the capsules of Sphagnum ... ... 27. *T. Sphagni.*

1. **Tilletia lævis**, *Kühn in Rabenh. Fung. Eur.* (1873), 1697.—Spore-mass produced in the ovary, deep brown with an olive tinge, foetid; spores globose, angularly globose, elliptic, &c., very variable in form and size, averaging 17-21 μ, or 15–26 × 10–15 μ, wall about 2 μ thick, pale olive-brown or sometimes almost cream-colour, epispore perfectly smooth.—Fischer de Wald., Aperçu (1877), 47; Wint. in Rabenh. Krypt. Flora, Pilze, i. (1884), 109; Sacc., Syll. vii. (1888), no. 1776. *T. fœtens*, Arthur in Bull. Agric. Exper. Stat. Indiana, no. 28 (1889), ex Journ. Myc. v. 165. *Ustilago fœtens*, Berk. & Curt. in Grevillea, iii. (1874), 59.

Host.—*Triticum vulgare*, Linn.

Hab.—England, France, Germany, Italy, Austria, Hungary, Russia, United States, Victoria.

Exsicc.—Rabenh. Fungi Eur. 1697; Roum. Fung. Sel. Exs., 5217; Sacc. Myc. Ven., 373; Ellis, N. Amer. Fungi, 1497; Rav. Fung. Carol., 100; Thümen, Myc. Univ., 1115; Flor. Exs. Austro-Hung. 352 (mixed with *T. Caries*); Thümen, Fung. Austr., 373.

The specimen in Rabenh. Fung. Eur., 1697, communicated by Kühn, and also Berkeley's type, examined.

Fig. 19, spore of *T. lævis*.

2. **Tilletia verrucosa**, *Cooke & Massee in Grevillea* xvii. (1888), 16.—Spores-mass occupying the ovary, pale brown, foetid. Spores globose or subglobose, pale yellowish brown, 20–25 μ diam., bristling with large, acute, pyramidal warts about 3 μ high. —Sacc. Syll. ix. (1891), no. 1177.

HOSTS.—*Panicum coloratum*, Linn.; *Ehrharta calycina*, Sm.

HAB.—Africa. Mozambique Distr., Portuguese East Africa, Lower Zambesi, between Lupata and Tete, *Kirk*. Cape Colony, in ovary of *Ehrharta* in herb. Thunberg.

Readily distinguished amongst species having warted spores by the pale yellowish brown or amber colour of the spores, and the large, pointed, pyramidal warts on the epispore. Type in herb. Kew.

Fig. 22, spore of *T. verrucosa*.

T Maclagani (Berk.) Clinton J. Myc. VIII, 148, 1902

3. **Tilletia rotundata**, *Massee*.—Spore-mass occupying the ovary, dark brown; spores globose or angularly globose, 20–25 μ diam., yellowish-brown, translucent, wall thick, epispore densely covered with minute warts.—*Ustilago rotundata*, Arthur in Bull. Iowa Agric. Coll., 1884, 173.

HOST.—*Panicum virgatum*, Linn.

HAB.—United States; Connecticut, South Manchester.

Exsicc.—Ellis & Everh., N. Amer. Fung., ser. 2, 1894.

Lacking the evidence afforded by germination, it is impossible to assign, with certainty, the generic position of this species; morphologically the spore characters indicate *Tilletia*.

4. **Tilletia mixta**, *Massee*.—Spore-mass blackish brown, formed in the ovary; spores globose, angularly globose, or broadly elliptic, averaging 16–18 μ diam., margin about 2 μ broad, deep chestnut brown, granulated or very minutely warted.—*T. fusca*, Ellis & Everh. in exsicc. not in Journ. Myc. iii. 55.

HOST.—*Eriochloa annulata*, Kunth; *Festuca microstachya*, Desv.

HAB.—Australia; Murrumbidgee, *Bennett*. United States; Idaho, Boise City, *Ellis & Everhart*.

Exsicc.—Ellis & Everh., N. Amer. Fung. ser. 2, 1895.

Allied to *Tilletia de Baryana* in spore-structure, but quite distinct in the rich chestnut colour of the spore, the much smaller warts or granulations on the epispore, and in being produced in the ovary.

Fig. 10, spore of *T. mixta*.

5. **Tilletia Ayresii**, *Berk., MS. in herb. Kew.*—Spore-mass buff, produced in the ovary ; spores globose or broadly elliptic, 13–16 μ or 12–13 × 16 μ, border 1·5–2 μ broad, very pale straw-colour, densely covered with very minute warts.

HOST.—*Panicum maximum*, Nees.

HAB.—Mauritius ; Hills above Port Louis, *Ayres*, 4754 in herb. Berkeley.

Readily recognised by the small, almost colourless, warted spores. Type in herb. Kew.

6. **Tilletia magnusiana**, *Fischer de Waldh., Aperçu* (1887), 47.—Spore-mass produced in the ovary, blackish ; spores globose, ovoid, flattened or pointed, 10–14 μ diam., or up to 12 × 16 μ, clear yellow-brown, epispore very densely granulose or almost papillose.—Sacc. Syll. vii. (1883), no. 1777.

HOST.—*Panicum geniculatum*, Willd.

HAB.—Antilles.

Distinguished among species developing in the ovary of the host by the very finely papillose epispore. Not examined.

7. **Tilletia rugispora**, *Ellis in Journ. Myc.* vii. (1893), 275, figs. 8 and 9.—Spore-mass formed in the ovary, pale greyish brown ; spores almost uniformly globose, pale brown, 16–22 μ diam., border 2–2·5 μ wide, not paler, epispore densely covered with small, flat-topped, irregularly shaped warts of a brown colour, formed by the cracking of the epispore during the growth of the spore, interstices paler.—Sacc. Syll. xi. (1895), no. 1337.

HOSTS.—*Paspalum undulatum*, Poir.

HAB.—United States, Brazos Co., Texas.

Exsicc.—Ellis & Everh. N. Amer. Fung., 2704.

The ornamentation of the epispore is described by Ellis as "tuberculose-reticulate, the reticulations about 1 μ high and 1·5 μ broad.

The surface of the epispore is cracked in a tesselated manner, the top of the warts being dark, and the cracks separating adjacent warts paler, presenting, on a surface view the appearance shown in fig. 8. Authentic specimen from Ellis, and also specimen in N. Amer. Fungi, 2704, examined.

Fig. 8, surface of spore ; fig. 9, spore of *T. rugispora*.

8. **Tilletia de Baryana**, *Fischer de Waldh. in Bull. Soc. Imp. Nat. Moscow*, xl. (1867), 251.—Spore-mass blackish brown, forming elongated streaks on the leaves of the host plant ; spores globose, rarely irregularly globose or broadly elliptic, brown, 10–18 μ diam., border not obvious, epispore densely covered with minute dark-topped warts formed by the breaking up of the epispore.—Fischer

de Waldh., Aperçu (1877), 48. *T. striæformis*, Wint. in Rabenh., Krypt. Flora, Pilze, i. (1884), 108.; Sacc., Syll. vii. (1888), no. 1774. *T. Milii*, Fuckel, Symb. Myc. (1869), 40; Fischer de Wald., Aperçu (1877), 48. *T. Calamagrostis*, Fuckel, Symb. Myc. (1869), 40; Fischer de Wald., Aperçu (1877), 49; Sacc., Syll. vii. (1888), no. 1775. *T. serpens*, Karsten, Fung. Fenn. (1883), no. 599, with description. *T. aculeata*, Ule in Verhandl. bot. Ver. Brandenburg, 1884, 213, and in Hedwigia, 1886, 112; Sacc., Syll. vii. (1888), no. 1785, under "species minus notæ." *T. alopecurivora*, Ule in Verhandl. bot. Ver. Brandenburg, 1884, 214, and in Hedwigia, 1886, 113; Sacc., Syll. vii. (1888), no. 1787, under "species minus notæ." *T. Brizæ*, Ule in Verhandl. bot. Ver. Brandenburg, 1884, 214, and in Hedwigia, 1886, 113; Sacc., Syll. vii. (1888), no. 1786, under "species minus notæ." *Uredo striæformis*, Westend. in Bull. Acad. Belg. 1851, 406. *Ustilago Salveii*, Berk. and Broome in Ann. Nat. Hist., ser. 2, v. (1850), 463. *Ustilago macrospora*, Desmaz., Crypt. France, sér. i. (1850), no. 2127.

Hosts.—A variety of grasses. Students of this genus have separated the forms chiefly by the hosts. There is no real difference, as far as I am aware; but for convenience of reference I class the hosts and forms together. As *T. de Baryana* (typical form), on *Anthoxanthum odoratum*, Linn., *Brachypodium pinnatum*, Beauv., *Festuca ovina*, Linn., *Holcus lanatus*, Linn., *H. mollis*, Linn, and *Lolium perenne*, Linn. As *T. striæformis*, on *Agrostis alba*, Linn., *A. vulgaris*, With., *Arrhenatherum avenaceum*, Beauv., *Briza media*, Linn., *Bromus inermis*, Leyss., *Dactylis glomerata*, Linn., *Deyeuxia halleriana*, Vaisey, *Festuca elatior*, Linn., *F. ovina*, Linn., *Holcus lanatus*, Linn., *H. mollis*, Linn., *Lolium perenne*, Linn., *Milium effusum*, Linn., *Phleum pratense*, Linn., *Poa pratensis*, Linn. As *U. Salveii*, on *Dactylis glomerata*, Linn., *Brachypodium pinnatum*, Beauv. and another grass. As *T. Milii*, on *Milium effusum*, Linn. As *T. Calamagrostis*, on *Agropyron repens*, Beauv., *Calamagrostis halleriana*, DC. and *C. lanceolata*, Roth. As *T. serpens*, on *Dactylis glomerata*, Linn. As *T. aculeata*, on *Agropyron repens*, Beauv. As *T. alopecurivora*, on *Alopecurus pratensis*, Linn. As *T. Brizæ*, on *Briza media*, Linn.

Hab.—Europe, except Russia and the Mediterranean region; United States.

Exsicc.—Under name of *Ustilago Salveii*, Cooke, Fung. Brit., 57; Westend., Herb. Crypt. Belg. 1164, Thümen, Fung. Aust., 840; Desmaz., Crypt. France, sér. 2, 1; Vize, Fung. Brit., 133. Under *Ustilago macrospora*, Desmaz., Crypt. France, sér. 1, 2127. Under *T. striæformis*, Rabenh.-Wint., Fung. Eur., 3503; Sydow, Myc. March., 1416, 1610, 2013, 2014, 3009; Ellis, N. Am. Fung., 1498. Under *T. de Baryana*, Rabenh., Fung. Eur., 1097, 2491, 3393; Westend., Crypt. Belg., 677; Thümen, Fung. Austr., 1230, and Fung. Univ., 1020; Sydow, Myc. March., 20, 26. As *T. Milii*, Fuckel, Fung. Rhen., 2410. As *T. Calamagrostis*, Fuckel, Fung. Rhen., 1925; Sydow, Myc. March., 2620; Zopf and Sydow, Myc. March, 10; Rabenh., Fung. Eur., 2694. As *T. aculeata*, Rabenh.-Wint., Fung. Eur., 3603. As *T. alopecurivora*, Sydow, Myc. March., 2120.

The types of most of these names have been seen. Berkeley's type is with his own specimens at Kew. Specimens illustrative of Desmazière's, Westendorp's, Fischer de Waldheim's, Fuckel's, Ule's and Karsten's names authenticated by these writers have been seen. Sydow's Myc. March., 2120, if correctly named, determines *T. alopecurivora* to be a form of *T. de Baryana*. Lastly, Ule's very unsatisfactory account of *T. Brizæ* makes this appear another form of the same species.

Fig. 6, sori ; fig. 7, spore of *T. de Baryana*.

9. **Tilletia arctica**, *Rostr. in Bot. Tidssk.*, 1886, 230.—Spore-mass forming black, very long, parallel streaks on the leaves and culms ; spores globose or ovoid, blackish-brown, 13–19 μ diam., epispore very minutely papillose.—Sacc., Syll. vii. (1888), no. 1781.

Host.—*Carex festiva*, Dewey.

Hab.—Finland.

Appears to be allied to *Tilletia de Baryana* : not examined.

10. **Tilletia epiphylla**, *Berk. & Broome in Trans. Linn. Soc.*, ser. 2, (Bot.) ii. (1882), 67. Spore-mass subpulverulent, brown, forming elongated pustules on the leaves of the host ; pustules gregarious, each seated on a small yellow spot, narrow, 1–2 mm. long ; spores globose, 35–38 μ diam. ; wall thin, pale brown, translucent ; epispore with exceedingly minute warts.—Sacc., Syll. vii. (1888), no. 1783.

Host.—*Zea Mays*, Linn.

Hab.—Queensland, *Bailey*, 228.

Berkeley and Broome describe the spores as smooth, but when carefully examined under a magnification of 400 diameters, the epispore is seen to be studded at regular intervals with very minute warts. The gregarious, small, linear pustules resemble a *Puccinia* superficially. Type specimen examined.

11. **Tilletia hyalospora**, *Massee*.—Spore-mass pale wood-colour, occupying the ovary. Spores globose or subglobose, 20–24 μ diam., border 2–2·5 μ wide ; surface reticulated ; there are usually 3–5 more or less parallel, simple or forked prominent ridges, connected by thinner and lower transverse bars.

Host.—*Piptochætium* sp.

Hab.—Bolivian Andes, near Sorata, about 11,500 ft. *Mandon*, 1275.

Characterised by the type of ornamentation of the epispore. A primary band appears as if wound in an oblique spiral round the spore, as in the carpogonium of a *Chara*, the more or less parallel lines formed by this band being connected by thinner,

transverse bars. The specimen occurred in the ovary of a species of *Piptochætium* in Mandon's Plantæ Andinæ Bolivianæ. Type in herb. Kew.

Fig. 1, spore of *T. hyalospora*.

12. **Tilletia Lolii**, *Auersw. in Klotzsch, Herb. Myc.* (1854), 1999. —Spore mass formed in the ovary, pale dull brown, foetid ; spores globose or sometimes broadly elliptic, pallid, averaging 20–25 μ diam., border 2·5–3 μ wide ; epispore furnished with thin ridges combined to form a shallow, small-meshed reticulation ; mesh averaging about 2 μ diam.—Fischer de Waldh., Aperçu (1877), 50 ; Wint. in Rabenh., Krypt. Flora, Pilze, i. (1884), 109 ; Sacc., Syll. vii. (1888), no. 1764.

Hosts.—*Lolium perenne*, Linn. ; *Lolium temulentum*, Linn.

Hab.—Germany.

Exsicc.—Klotzsch-Rabenh., Herb. Myc., 1999.

Distinguished by the pale colour of the spore-mass, and the pale ochraceous or almost colourless spores when viewed by transmitted light, the thin ridges, and small, shallow network. Specimen from quoted exsiccata examined.

Fig. 21, spore of *T. Lolii*.

13. **Tilletia controversa**, *Kühn in Rabenh. Fung. Eur.* (1874), no. 1896, with description. Spore-mass blackish, produced in the ovary, foetid ; spores almost uniformly globose, pale brown, 18–25 μ diam., margin 3 μ wide, not paler, epispore furnished with ridges anastomosing to form a rather large-meshed network, mesh averaging 3–3·5 μ diam. Mycelium perennial in the rhizome of the host-plant.—Fischer de Wald., Aperçu (1877), 49 ; Wint. in Rabenh., Krypt. Flora, Pilze, i. (1884), 110 ; Sacc., Syll. vii. (1888), no. 1765. *T. calospora*, Passerini in Grevillea, v. (1876), 47 ; Fischer de Waldh., Aperçu (1877), 48 ; Wint. in Rabenh., Krypt. Flora, Pilze, i. (1884) 110; Sacc., Syll. vii. (1888), no. 1767.

Hosts.—*Agropyron repens*, Beauv. ; *Agropyron glaucum*, Roem. & Schult. ; *Alopecurus agrestis*, Linn. ; *Elymus aralensis*, Regel.

Hab.—Italy, Germany, Austria, Turkestan.

Exsicc.—Rabenh., Fung. Eur., 1896 ; Roum., Fung. Sel. Gall., 4624 ; Flor. Exs. Austro-Hung., 351 ; Kunze, Fung. Sel., 210 ; Thümen, Myc. Univ., 1217 ; Rabenh., Fung. Eur., 2492 ; Roum., Fung. Gall. 1699.

Differs from *Tilletia endophylla* and from *T. Caries*, in the larger reticulations. *T. Rauwenhoffii* differs, on the other hand, from the present species in the much larger reticulations, and in the broader and almost colourless border of the spore.

The specimen of *T. controversa* in Rabenh., Fung. Eur., 1896, is authentic material and was communicated by Kühn. An authentic specimen of *T. calospora*, Passer., from the author also examined.

Fig. 18, spore of *T. controversa*.

14. **Tilletia cerebrina**, *Ellis and Everh. in Journ. Myc.* iii. (1887), 56.—Spore-mass formed in the ovary, dark brown or blackish ; spores globose or sub-globose 23–28 μ and up to 30 μ long when ellipsoid, dark brown, border about 2·5 μ thick, paler ; epispore ornamented with thickish ridges which are more or less sinuous and branched, the branches not unfrequently combining here and there to form an irregular reticulation, but free ends of the ridges are usually present in considerable numbers ; mesh varying from 2–5 μ diam.—Sacc., Syll. vii. (1888), no. 1768.

Host.—*Deschampsia cæspitosa*, Beauv.

Hab.—United States ; Rocky Mountain region.

Characterised by the bands on the epispore being irregularly branched and as a rule having numerous free ends, although in some spores the reticulation is fairly uniform and free ends rare or absent. Authentic specimen from Ellis examined.

Fig. 12, spore of *T. cerebrina*.

15. **Tilletia buchloeana**, *Keller & Swingle in Journ. Myc.* v. (1889), 11.—Spore-mass formed in the ovary, dirty brown ; spores globose or very slightly oval, 16·5–18 × 20–21 μ, brownish ; epispore marked with scattered regular spines or faint reticulations (formed by coalescence of the spines ·5–1·5 μ high, covered by the outer hyaline layer, which is 1·5–4 μ thick.—Sacc., Syll. ix. (1891), no. 1178.

Host.—*Buchloe dactyloides*, Engelm.

Hab.—United States ; Kansas.

The fungus is borne on the male plants. In its presence often all or nearly all the staminate spikelets produce the ovaries, all of which are infested. The few female plants collected in the same localities were free from the fungus (*Keller & Swingle*). Judging from the figures the spores are reticulated at maturity. Not examined.

16. **Tilletia separata**, *Kunze, in Josh. Kunze, Fung. Select. Exs.* (1874), 29.—Spore-mass formed in the ovary, blackish brown, foetid ; spores globose, irregularly or angularly globose, or broadly elliptic, clear brown, 20–27 μ diam., border about 3 μ wide, not appreciably paler ; epispore with raised ridges anastomosing to form an irregular, small-meshed network, mesh averaging 1·5–2·5 μ diameter.—Wint. in Rabenh., Krypt.-Flora, Pilze i. (1884), 111 ; Sacc., Syll. vii. (1888), no. 1766. *T. decipiens*, Wint. in Rabenh.,

Krypt. Flora, Pilze i. (1884), 111; Sacc., Syll. vii. (1888), no. 1762. *T. Secalis*, Kühn in Fischer de Waldh., Aperçu (1877), 50; Wint. in Rabenh., Krypt. Flora, Pilze i. (1884), 110; Sacc., Syll. vii. (1888), no. 1763. *Erysibe sphærococca* α *Agrostidis*, Wallr., Flora Germ. Crypt. iv. (1833), 213. *Uredo decipiens* α, Strauss in Wetterau Gesell. Ann. ii. (1810), 111. *Uredo Secalis*, Corda in Hlubek, Œconom. Neuigk, 1848, 9, t. i. *Uredo segetum var. decipiens*, Pers., Syn. Fung. (1801), 225. *Uredo* (*Ustilago*) *sphærococca*, Rabenh., Krypt. Flora, Pilze ii. (1846), 213.

Hosts.—*Secale cereale*, Linn.; *Apera Spica-venti*, Beauv.; *Agrostis alba*, Linn.; *Agrostis vulgaris*, With. (*Agrostis pumila*, Linn., is a form of *A. vulgaris* dwarfed by the *Tilletia*).

Hab.—Britain, France, Germany, Switzerland, Russia.

Exsicc.—Rabenh., Fung. Eur., 2191; Zopf & Sydow, Myc. March. 19; Flor. Gall. et Germ. Exs., 786; Roum., Fung. Sel. Exs. 5,706; Josh. Kunze, Fung. Sel. Exs., 29.

Distinguished from *Tilletia Caries* by the wider border of the spore and the smaller reticulations. The spores of *Tilletia endophylla* resemble those of *T. separata*; the first named, however, differs in forming the spore-mass in the leaves and not the ovary of the host. Examination of material in the exsiccata quoted above has been made.

Figs. 17 and 20, spores of *T. separata*, in one case germinating.

17. **Tilletia Caries**, *Tul. in Ann. Sci. Nat.*, sér. 3, vii. (1847), 113, t. 5, figs. 1–16.—Spore-mass produced in the ovary, blackish, with an olive sheen, foetid; spores globose, brown, 17–22 μ diam., border 1–1·5 μ, not paler; epispore furnished with ridges anastomosing to form a rather large-meshed network; mesh often variable in size and form, averaging about 3–3·5 μ.—Fischer de Waldh., Aperçu (1877), 49. *T. Tritici*, Wint. in Rabenh., Krypt. Flora, Pilze, i. (1884), 110; Sacc., Syll., vii. (1888), no. 1760. *Lycoperdon Tritici*, Bjerk. in Act. Suec., 1775, 326; *Uredo Caries*, DC., Fl. France, vi. (1815), 78. *Uredo sitophila*, Ditm. in Sturm, Deutchl. Flora, Abt. 3, pt. 1 (1817), 69.

Hosts. — *Triticum vulgare*, Vill.; *Triticum Spelta*, Linn.; *Triticum monococcum*, Linn.

Hab.—Britain, France, Germany, Austria, Italy, Belgium, Switzerland, Russia, Finland, Algeria, Queensland, Victoria, United States, Chile.

Exsicc.—Rabenh. Fung. Eur., 2395; Cooke, Brit. Fungi, 53; Cooke, Fung. Brit., ed. 2, 429; Briosi e Cavara, Fung. Parasit., 155 (with figs.); Ellis and Everh., N. Amer. Fungi, 3236; Roum., Fung. Gall. Exs., 1645; Fuckel, Fungi Rhen., 252; Thümen, Myc. Univ., 724; Sydow, Myc. March., 2621; Vize, Fung. Brit., 130; Berk., Brit. Fungi, 113; Desm., Crypt. France, sér. 1, 124; Thümen, Fung. Austr., 343; Zack, Leiner u. Sitzenb., Krypt. Badens, 401; Sacc., Myc. Ven., 1153 (mixed with *Tilletia laevis* Kühn); Holl, Schmidt und Kunze, Deutschl. Schwamme, 190.

Remarkable for the narrow coloured border of the spore. Somewhat resembling in spore-characters *Tilletia endophylla*. The spores of the latter are, however, larger, darker in colour, with a wider border, and altogether larger in size; moreover, *T. endophylla* forms elongated blackish streaks on leaves, and is not produced in the ovary.

Fig. 13, *T. Caries* in an ear of wheat; fig. 14, spore; fig. 15, two sporidia after conjugation.

18. **Tilletia Elymi**, *Dietel and Holway in Bot. Gaz.*, xix. (1894), 305.—Spore-masses black, destroying the ovaries; spores globose, dark olive brown, 24–28 μ diameter. Epispore reticulated with ridges 2·6–4 μ high and about 3 μ apart.—Sacc., Syll. xi. (1895), no. 1338.

Host.—*Elymus* sp.

Hab.—United States; Skamania co., Washington State, *W. N. Suksdorf.*

Appears to be closely allied to *Tilletia controversa*, Kühn, which has also been recorded as occurring in the ovary of a species of *Elymus*. Not examined.

19. **Tilletia inolens**, *McAlpine in Agric. Gaz. of N. S. Wales*, vii. (1897), 154, figs. 30–33.—Produced in inflorescence and on upper leaves, black, powdery, without smell. Mycelium septate, hyaline, 4–5 μ thick. Spores globose, dark brown, 28–36 μ diam., average 33 μ; ridges of epispore 4 μ high, yellowish brown; meshes polygonal, about 4–5 μ diameter.

Host.—*Deyeuxia Forsteri*, Kunth.

Hab.—Victoria, Ardmona.

Not examined. Appears to be most closely allied to *T. Rauwenhoffii*, Fischer de Waldh.

20. **Tilletia Rauwenhoffii**, *Fischer de Waldh., Aperçu* (1877), 50.—Spore-mass produced in the ovary, blackish; spores almost constantly globose, olive-brown, 25–30 μ diam.; border almost colourless, 3–4 μ wide; epispore ornamented with prominent ribs anastomosing to form a network of large irregularly hexagonal reticulations; mesh averaging 3·5–4 μ diameter.—Sacc., Syll. vii. (1888), no. 1769. *Polyactis Holci*, Westend. in Bull. Acad. Belg., sér. 2, xi. (1889) 660, fig. 1.

Hosts.—*Holcus lanatus*, Linn., *Holcus mollis*, Linn.

Hab.—Belgium, England, Ireland.

Exsicc.—Rabenh.-Wint., Fung. Eur., 3104; Roum., Fung. Gall., 3509.

Readily distinguished by the very large size of the network on the epispore, usually only 4–6 areolæ being present on a

hemisphere ; also by the very wide, almost colourless, border. Authentic specimens from Westendorp and Fischer de Waldheim examined.

Fig. 4, spore of *T. Rauwenhoffii ;* fig. 5, the fungus on *Holcus mollis.*

21. **Tilletia fusca,** *Ellis & Everh. in Journ. Myc.* iii. (1887), 55.—Spore-mass occupying the ovary, dark olive-brown ; spores globose or sub-globose, 16-25 μ diam., brown border about 2 μ broad, paler ; the epispore ornamented with raised ridges anastomising to form an irregular network ; mesh averaging 3 μ diameter.—Sacc., Syll. vii. (1888), no. 1771. *T. asperifolia,* Ellis and Everh. in Journ. Myc. iii. (1887), 55 ; Sacc., Syll. vii. (1888), no. 1772. *T. montana,* Ellis and Everh. in Journ. Myc. iii. (1887), 55 ; Sacc. Syll. vii. (1888), no. 1773.

Hosts.—*Festuca microstachya,* Desv. (?) ; *Sporobolus asperifolius,* Nees and Meyen ; *Sporobolus gracillimus,* Vasey.

Hab.—United States, Rocky Mountain region.

Allied to *Tilletia Caries,* but distinguished by the spore-mass not being foetid, the larger spores, larger and more irregular reticulations, and border paler than the remainder of the spore. Specimens illustrating the species and its two synonyms enumerated above were received from Ellis. The specimen from the author called *T. fusca,* agrees exactly with the original description of this species in *Journ. Myc.* iii. (1887), 55. On the other hand, further material issued under the name of *Tilletia fusca* (Ellis and Everh., N. Amer. Fung., ser. 2, 1895, in ovary of *Festuca microstachya,* from Boise City, Idaho) does not at all agree with the diagnosis of the species as quoted above, but has the epispore densely and minutely warted, and is identical with *Tilletia mixta,* Massee.

The priority of the specific name *fusca* turns on this name standing first in order on the same page where *montana* and *asperifolia* are also described.

Fig. 11, spore of *T. fusca.*

22. **Tilletia Hordei,** *Körn. in Hedwigia,* 1877, 30. Spore-mass formed in the ovary, blackish-brown ; spores globose or broadly elliptic, brown 19·5–20·5 μ diam., or 19 × 21 μ, border about 2·5 μ thick, epispore covered with a small-meshed network ; mesh averaging 2 μ diameter.—Sacc. Syll. vii. (1888), no. 1770. *T. Trabuti,* Jaczewski in Bull. Soc. Myc. France, ix. (1893), 50.

Hosts.—*Hordeum fragile,* Boiss. ; *Hordeum murinum,* Linn.

Hab.—Turkey, Assyria, Algeria.

Closely resembling *Tilletia Caries* in spore-structure ; the border is a little wider in the present species. Specimen from Algiers examined.

Fig. 24, spore of *T. Hordei.*

23. **Tilletia zonata**, *Brefeld, Unters. Mykol.* xii. (1895), 161, t. x., figs. 3–7.—Spore-mass formed in the flower-bud, blackish; spores globose, 15–18 μ diam., with a thin external gelatinous layer; epispore brown, furnished with slightly raised ridges anastomosing to form a network.—Hedwigia, Beibl. (Elench. Fung. nov.), 1896, xxi.

Host.—*Sporobolus ligularis*, Hackel.

Hab.—Ecuador.

The above is vaguely and briefly described by Brefeld in the work quoted; the mode of germination is however given in detail, and beautifully illustrated. Apparently closely allied to *Tilletia fusca*.

24. **Tilletia endophylla**, *de Bary in Rabenh., Herb. Myc.*, ed. 2, 500.—Spore-mass forming blackish-brown streaks on the leaves of the host 1–3 cm. long; spores globose, angularly globose, or broadly ellipsoid, 18–25 μ diam., border about 2 μ wide, altogether brown; epispore ornamented with a rather small-meshed reticulation, the walls of which are thickish; mesh averaging about 2 μ diameter.—Fischer de Waldh., Aperçu (1877), 49; *T. olida*, Wint. in Rabenh., Krypt. Flora, Pilze, i. (1881), 107; Sacc., Syll. vii. (1888), no. 1761; *Uredo olida*, Riess, in Klotzsch-Rabenh., Herb. Myc., 1695.

Hosts.—*Brachypodium pinnatum*, Beauv.; *Brachypodium sylvaticum*, Beauv.

Hab.—Austria, Germany.

Exsicc.—Klotzsch-Rabenh., Herb. Myc., 1695; Rabenh., Herb. Myc., ed. 2, 500; Rabenh., Fung. Eur., 2293; Rabenh.-Wint., Fung. Eur., 3703.

The only species with reticulated spores that forms long sori, or streaks, on leaves. The reticulations are smaller and more numerous than in *Tilletia Caries*. Specimens from the exsiccata quoted above, examined.

Fig. 16, spore of *T. endophylla*.

25. **Tilletia Sesleriæ**, *Juel in Öfvers. af Kongl. Vet. Akad. Förhandl. Stockholm*, 1894, 494.—Spore-mass forming very long, thin black streaks on the leaves; spores irregularly globose, dark brown, 25–28 μ diam., epispore furnished with ridges which anastomose to form a network.

Host.—*Sesleria cærulea*, Ard.

Hab.—Gothland.

The author compares this species with *Tilletia endophylla*, Wint., from which it differs more especially in the larger spores. Not examined.

26. **Tilletia Berkeleyi**, *Massee*.—Spore-mass forming blackish streaks on the culm, up to 1 cm. long, not foetid when moistened; spores constantly globose, brown, 15–18 μ diam., border 1 μ wide,

epispore furnished with very thin, slightly raised ridges, which anastomose to form a very small-meshed network ; mesh averaging 1·5 μ diameter.

Host.—*Triticum vulgare*, Vill.

Hab.—England ; King's Cliffe, Northamptonshire, *Berkeley*.

A very distinct species, included by Berkeley under *Tilletia Caries*, in his herbarium. Differs from the last-named, and from all other described species in the small-sized spores, and in the very small mesh formed by the thin, slightly raised ridges on the epispore. Forming blackish lines on the culm ·5–1 cm. long.

Fig. 23, spore of *T. Berkeleyi*.

27. Tilletia Sphagni, *Nawaschin in Bot. Centralbl.* 43 (1890), 289.—Spore-mass brown, filling the capsules of *Sphagnum* ; spores globose, 11–12 μ diam. : epispore clear brown, ornamented with a polygonal network.—Sacc. Syll. ix. (1891), no. 1180.

Host.—*Sphagnum squarrosum*, Pers.

Hab.—Russia.

This species is probably widely diffused, although only definitely recorded from Russia. The *Tilletia* spores are those bodies which have previously been spoken of as the microspores of *Sphagnum*, and the capsules in which they are produced were known as microsporangia. Not examined.

Doubtful Species.

28. *Tilletia Avenæ*, Ule in Hedwigia, 1886, 113 ; Sacc. Syll. vii. (1888), no. 1784.

There is no published description of this species.

29. *Tilletia Fischeri*, Karsten in Finska Vetenskaps-Societeten, 1879, 10 ; Myc. Fenn. iv. p. 10.—Spore-mass formed in the ovary, black ; spores globose or sub-globose, brown, about 14 μ diam. or 16 × 12 μ.—Sacc., Syll. vii. (1888), no. 1799.

Host.—*Carex canescens*, Linn.

Hab.—Finland.

The brief and incomplete diagnosis prevents placing this species in any one section employed in the present paper, and it is not wise to trust to the host for the discrimination of a species.

30. *Tilletia Vulpiæ*, P. Magnus in Verhandl. d. Zool.-Bot. Gesell. Wien, xlix. (1899), 89, t. 2, figs. 7–12. Spore-mass produced in the ovary, blackish, 19·2 × 16·9 μ ; epispore with a raised network.

HOST.—*Festuca Myurus*, Linn.

HAB.—Kurdistan.

Not examined. The diagnosis is too vague to admit of indicating its affinities.

Excluded Species.

31. *Tilletia corona*, Scribner in Bot. Gaz. xxiii. (1896), 210.

HOSTS.—Infesting the ovary in *Leersia oryzoides*, Swartz; *L. virginicus*, Willd.; *L. lenticularis*, Michx.; *Panicum virgatum*, Linn.; *P. sanguinale*, Linn.; and *Oryza sativa*, Linn.

HAB.—United States.

Exsicc.—Ellis, N. Amer. Fung., 1896.

This is obviously a species of ***Neovossia***, and will stand as *Neovossia corona*. The specimen in Ellis, N. Amer. Fung. 1896, examined.

32. *Tilletia* (?) *glomerulata*, Cocc. et Mor., Enum. Funghi, Bologna, Cent. ii., 6, tab. 1, figs. 1–3; Sacc., Syll. vii. (1888), no. 1782.

Judging from the description and figures, this is certainly not a species of *Tilletia*.

33. *Tilletia? irregularis*, Pazschke in Rabenh.-Wint.-Pazschke Fung. Eur. et Extra-Europ., 4004 (with description); Hedwigia, Beibl. (Elench. Fung. nov.), 1896, xxi.

HOST.—On living leaves of *Andropogon* sp.

HAB.—Brazil; Sta. Catharina.

Examination of material from the exsiccata quoted above shows very clearly that the fungus is not a *Tilletia*, but some Hyphomycetous form with dark olive spores arranged in lines, and distinctly springing from a pseudoparenchymatous stroma immersed in the substance of the leaf.

34. *Tilletia Moliniæ*, Wint. in Rabenh., Krypt. Flora, Pilze, i. (1884), 109; Sacc., Syll. vii. (1888), no. 1778. *Neovossia Moliniæ*, Körn. in Oester. Bot. Zeitschr. xxix. (1879), 217; Brefeld, Unters. Mykol. xii., 210, t. x., fig. 8–28. *Vossia Moliniæ*, Thümen in Oester. Bot. Zeitschr. xxix. (1879), 18.

HOST.—In ovary of *Molinia cærulea*, Moench.

HAB.—Carniolia.

EXSICC.—Roum., Fung. Sel., 4922 (comm. Voss); Flor. Ex. Austro-Hung., 353 (comm. Voss); Thümen, Fung. Austr., 1216.

This species differs from *Tilletia* in the mode of spore-germination, and must consequently return to *Neovossia*; *Vossia*, the name originally given by Thümen, being already used for a genus of grasses. Portion of the type specimen sent by Thümen to Herb. Kew, also the material in the quoted exsiccata, examined.

Figs. 2 and 3, spores of *Neovossia Moliniæ*.

35. *Tilletia Orizæ*, Pat. in Bull. Soc. Myc. France, iii. (1887), 124, t. x., fig. 2.—Spores globose or ovoid, 3–5 μ diam., olive brown, warted, united into a hard blackish green mass, mixed with slender hyaline filaments with an irregular outline.—Sacc., Syll. ix (1891), no. 1179.

Host.—Attacks the fruit of rice, *Oryza sativa*, Linn., which becomes enlarged, black, and hard like a sclerotium.

Hab.—Japan; Environs of Yokosha, Island of Nippon.

The description proves that this fungus is not a *Tilletia*, in fact it forms the type of a new genus—*Ustilaginoidea*, established by Brefeld, who cannot indicate its affinities. There are two species, *U. Oryzæ* and *U. Setariæ*. Perhaps it would have been wiser not to have established a new genus until it could have been diagnosed by other features than spore-germination alone. Every mycologist is deeply indebted to Brefeld for his marvellous researches on spore-germination, but as to whether mycologists have accepted the idea that everything systematic rests on this one feature, or whether it is really to be regarded as the fundamental and only feature of value, remains yet to be decided.

36. *Tilletia sterilis*, Ule in Verhandl. bot. Ver. Brandenburg, 1884, 214; Hedwigia, 1886, 114; Sacc., Syll. vii. (1888), no. 1788, under "Species minus notæ."

Host.—*Festuca ovina*, Linn.; *Kœleria cristata*, Pers.

Hab.—Germany.

Exsicc.—Rabenh.-Wint., Fung. Eur., 3605 (comm. Ule).

The different accounts of this hypothetical species, as given by Ule, are very unsatisfactory. The author on finding certain black streaks on leaves appears to have assumed that a *Tilletia* was the cause, but lacking satisfactory evidence called the species *sterilis*, probably as a reproach for its sterility. The specimen furnished by Ule to Rabenhorst's exsiccata conforms with the specific name, and may, so far as the Kew copy is concerned, be described as *sterilis*.

37. *Tilletia Thlaspeos*, Beck in Verhandl. Zool.-Bot. Gesell. Wien, 1885, 361.—Spore-mass ochraceous, produced in the ovules; spores globose or rarely subglobose, ochraceous, semipellucid, 14·7–17·5 μ diam.; epispore densely verruculose-aculeate.

HOST.—*Thlaspi alpestre*, Linn.

HAB.—Austria.

Developing in ovules of scarcely deformed fruit of *Thlaspi alpestre*. Not examined. Judging from the description, the present fungus is not a *Tilletia* but a *Sorosporium*.

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DCLVII.—CENTRAL AMERICAN RUBBER.

(*Castilloa elastica*, Cerv.)

Some account of *Castilloa* rubber, and of the species producing it, was given in the *Kew Bulletin* for 1887, pp. 13–16. Since then its cultivation as a source of rubber-supply has attracted some attention in Mexico and the West Indies. It has not, however, been easy to obtain any trustworthy data as to the practical methods to pursue or as to the cost and return to be expected. The following account is therefore reprinted from the United States Consular Reports (May, 1899, pp. 147–151). It appears to have been drawn up by a man conversant with the subject and with a good deal of care :—

"Consul-General Beaupré sends from Guatemala, under date of January 28, 1899, a translation of an article on rubber prepared by Mr. José Horta, of the city of Guatemala. Mr. Horta, adds the Consul-General, is an experienced agriculturist, and has handled the subject ably. Extracts from his report are given below.

"In Guatemala *Castilloa elastica*, Cerv., is found in the wild state, and covers an immense zone in Central America; the rubber which this tree produces is one of the best and most valuable for the industry.

"The *Castilloa elastica* is a tall, well-shaped tree, with smooth, greenish-white bark. At a height of from 15 to 20 yards from the ground there start from the trunk (of spongy and porous

wood) large and almost horizontal branches, from which hang two rows of leaves, long, oval in shape, and smooth edged (not toothed).

"The milk of the rubber tree, or its mercantile product, is contained principally in the fibres between the woody portion of the tree and the bark. This fibrous part is a vital portion of the tree. For this reason, in making incisions in the bark to obtain the milk, it is necessary to proceed with great caution and according to the method described further on.

"The milk contains more or less water, according to the time of its extraction; on an average it can be calculated to hold about 60 per cent. water and other substances, and 40 per cent. saleable product; of this, approximately 33 per cent. is rubber of superior quality.

"The climate most appropriate for rubber is the hot or coastal, with a temperature of from 25° to 35° Celsius (93° to 103° F.) and the altitude above sea level up to 1,500 feet. The ground should be moist, deep, and loose; neither clay nor stone. Rubber should not be planted in the sun, We found our opinion upon the following reasons :—

"(1.) The nature of the rubber tree.
"(2.) The trials made in Guatemala since 1872.
"(3.) The consideration that, planting in the shade, there is absolute certainty of a satisfactory result.

"If the wild tree always seeks the shade of trees of greater growth in the natural forests, it is because, by the help of these, its sap remains in the state imposed by nature as a condition of its proper growth and production. It is not the desire here to make a detailed study of the tree; but we wish to note that its leaves do not resist the sun, nor do they, by the nature of their surface, oppose evaporation. It is clear that without shade there is an evaporation which must exercise a harmful influence upon the production of the milk of the tree. It should also not be lost sight of that on the Pacific Coast we have a dry season for six consecutive months, very prejudicial to plantations in the sun. Allow the rubber tree a high and well-distributed shade, without undergrowth or brush, and the result will be healthy and robust trees of rapid growth, long life, and abundant yield. It is a mistake to wish to cultivate plants, such as coffee and rubber, requiring distinct climatical conditions, soil, and atmospheres, with the desire of obtaining good yields in both. The result is that neither one nor the other finds the requirements necessary for proper development. It would appear much more feasible to conduct the cultivation of vanilla simultaneously with that of rubber, utilizing the trees for shade.

"Advocating the planting in the shade is equivalent, in a country like Guatemala, still possessing so much virgin forest, to planting in the woods. There are thousands of acres of land where it would be sufficient to clear the forest (cutting down part and removing the low branches and undergrowth) in order to obtain ground sufficiently shaded and with the necessary ventilation, the latter a condition of the greatest importance. The trees and undergrowth cut down could be spread over the ground to

prevent the growth of weeds, as well as to serve as manure. In planting the rubber tree the ground should be perfectly cleaned for a circle at least a yard in diameter and the tree placed in the centre. We advise the planting of trees taken from a nursery, as incomparably better results will be obtained than by planting by seed. The nursery is formed in damp ground, shaded and well worked, and the seed (which is gathered here in March and April) planted at intervals of about a foot. The seed is planted just as gathered, with gum and all ; washing may injure the later growth and may even prevent sprouting. After a year in the nursery the trees are taken out with great care (it is best if the earth adheres to the roots) and transplanted.

"The least distance at which rubber trees should be set out is 6 yards apart, and they should be in straight rows so far as possible ; if a choice can be made, 8 to 10 yards would be preferable. During each of the first two years, from three to four cleanings should be made, these to consist principally of cutting with the machete the undergrowth which has sprouted, and covering the ground as has previously been explained. In the third and fourth years, two to three cleanings per year should be made ; and from the fifth year, one cleaning annually will suffice until the growth of the tree impedes the further development of weeds. Before beginning to exploit, the trunk of the tree should measure at least 12 inches in diameter, and from 12 to 15 yards in height, for which from nine to ten years is necessary.

"The milk may be extracted from the trees twice each year, during the rainy season ; about two months after its commencement and towards the termination, the most propitious time being when the tree has dropped its leaves.

"A tree planted and cultivated under good conditions will give an annual product, after nine or ten years, of 1 pound of rubber, or, say $2\frac{1}{2}$ to 3 pounds of milk. With proper study of the nature of the rubber tree, the progress of its sap, and the fertilizers that might be best for it, it is very probable that this yield would be greatly increased.

"EXTRACTION OF RUBBER.

"Until now, the machete has been used in Guatemala to make the incisions in the bark, incisions in the form of small canals about three-fourths of an inch wide, which receive the milk. In other countries (as in the East Indies) there is employed a kind of knife, which allows the making of an incision which is cleaner and better directed.

"To extract a good quantity of milk it is not sufficient to make only one incision at the foot of the tree. Care should be taken that the bark of the tree remains intact in one continuous strip the entire height of one side of the tree ; if the entire circumference of the trunk were cut (even by incisions situated at different heights), the tree would die within a few days. To avoid this danger we have seen the following modes employed :—

"(1.) From a certain height above the roots, incisions are made in the trunk every metre or metre and a quarter approximately, until within two metres of the first branches. Each incision

consists of two symmetrical cuts, which together will cover two-thirds of the circumference of the tree, and will form an angle of 45°, in order that the milk may run freely to the lowest point. The points of all the incisions must be in a perpendicular line, so that the milk from the highest incision, after concentrating in the angle formed by the two cuts, may run to the lowest point of the next lower incision, and from there on to the following, etc., until reaching the lowest, where it is collected, as explained further on.

"(2.) The incision is extended to the same height of the trunk as indicated in the first method, but is continuous, and consists of cuts, one perpendicular to the other, always taking care never to cut into more than two-thirds of the tree's circumference, thus leaving one-third of the bark intact.

"It is useless and even dangerous to make the incisions so deep as to penetrate the woody part of the tree. On the contrary, great caution should be exercised to preserve the fibres closest to the wood.

"From the point of the incision nearest the ground the milk is conducted by a canal to a receptacle of clay or wood. When collected thus, the milk must be coagulated to obtain the solid marketable product. This part of the process merits a serious study, as the best mode of obtaining the finest and most abundant product has not been decided. We limit ourselves to indicating the principal processes we have seen employed.

"The most rudimentary consists in collecting the milk in a trough, or even a hole excavated in the ground (which detracts from its value), and employing in its coagulation the juice of the vine, here called 'Quiebra-Cajete' (an infusion of the leaves of the vine). Alum can also be employed, and exercises a very rapid action on the milk. The water contained in the milk may be evaporated by indirectly applied heat, taking care that the receptacle does not communicate a bad colour to the rubber; or, the milk may be mixed with water, which is poured off at intervals, until all impurities are removed. The clean rubber, which presents the aspect of a spongy mass, is passed through a press to expel the water, thus obtaining a white product of superior quality, which is left to dry in the shade, in order that it may not show on the outside a glutinous liquid, which detracts from its market value.

"Cost and Probable Production of a Plantation.

"This calculation must naturally be incomplete, as the cost will depend in great part on the price of the lands, on the greater or less facilities for obtaining workmen, the mode of paying them (by day, by task, with advances, etc.), on the distance apart that trees are to be planted, whether the land is to be used exclusively for rubber or not, and on many other considerations.

"The figures expressed herewith, therefore, do not pretend to a rigorous exactitude, but will serve as a guide for the agriculturist.

"We will suppose that the trees are to be planted at 8 varas (1 vara = 33 English inches) distance, so that each will have an approximate area (with space occupied by shade trees) of 64 square varas, which we believe necessary for their proper development,

thus allowing approximately 10,000 trees to the caballeria (112 acres); cost of land at $400 ($175.60 in United States currency) * per caballeria, a price somewhat high, as some coast land (hot) adequate for this cultivation can be purchased in Guatemala for less; but we have adopted this figure, as, according to existing laws, it is the average cost of public lands in the Republic.

	Guatemalan currency.	United States currency.
	$	$
Cost per manzana †	6.25	2.74
Fencing per manzana...	10.00	4.39
Nursery, at $10 per 1,000, say, for 159 plants...	1.59	.69
Preparation of ground and arranging natural shade, per manzana ...	8.00	3.51
Planting 159 trees to the manzana ...	3.00	1.32
Cleaning by machete, four in first year	16.00	7.02
Three cleanings in second year ...	12.00	5.27
Two cleanings in third year	8.00	3.51
One cleaning each year from fourth to sixth, inclusive	12.00	5.27
Interest on invested capital, at 10 per cent. for ten years	68.78	30.19
Management, etc.	4.38	1.92
Total cost in Guatemala (200 per cent. premium is ruling rate on gold to-day) of 159 trees occupying a manzana of ground, and 10 years old	150.00	66.00

"From the foregoing calculation it may be seen that a plantation of, say, 100,000 trees requires 10 caballerias of ground (besides that which may be necessary for buildings, huts, etc.), and would cost, after ten years, about $95,000 ($41,700).

"If the annual yield of each tree after ten years is 1 pound of rubber of good class, 100,000 trees would give 1,000 centals per year of good rubber. At present price of the article, these 1,000 would be valued in Guatemalan money at to-day's exchange $262,500 ($115,238). There is to be deducted from this :—

	Guatemalan currency.	United States currency.
	$	$
Cost of extraction and collection of the milk and manufacture of product (which together may be calculated at 30 cents per pound of rubber) for 1,000 centals	30,000	13,170

* The value of the Central American peso, or dollar, was estimated by the United States Director of the Mint, January 1st, 1899, at 43.9 cents.

† Square of 100 varas, or 275 feet.

	Guatemalan currency.		United States currency.
	$		$
Brought forward	30,000	...	13,170
Expense of transportation to point of shipment (which varies in each case, but can be calculated in lands situated on the Pacific coast at $1.50 to $2 per cental) for 1,000 centals	1,750	...	768
Expense for embarking, more or less, 80 cents per cental, or, for 1,000 centals	809	...	355
Ocean freight, insurance, commission on sales, and other expenses, approximately	40,000	...	17,560
Total	72,559	...	31,853

"Deducting the cost of $72,559 ($31,853) from the income, leaves a balance of $189,941 ($83,385).

"According to these calculations, one crop, after ten years, will produce double the amount expended during that time. Even reducing these figures (which are not too high) to one-half, in order to be free from any exaggeration, and supposing a yield per tree of 6 ounces of good product, the net annual product will be incomparably more remunerative than that which coffee under the best and most favourable circumstances can yield."

DCLVIII.—FUNGI EXOTICI, II.

Persia.

Uredineæ.

Puccinia decipiens, *Massee* (*sp. nov.*). *Sori* amphigeni, minuti, gregarii, orbiculati, atro-brunnei, sæpe epidermide cincti, 1–2 mm. diam. *Teleutosporæ* ovoideæ vel suboblongatæ, vertice rotundatæ nec incrassatæ, medio septatæ pleræque vix constrictæ, fuscæ, 50–55 × 28–32 μ, episporio leves, basi in pedicellum hyalinum 60× 6–7 μ productæ.

South Persia. Province of Kerman, 10,000 ft., on leaves of *Taraxacum montanum*, C. A. Mey., *Bornmüller*, 5138.

Somewhat resembling *P. Prenanthis*, Fuckel, in habit and general appearance, but differing in the structure of the teleutospores.

Russian Asia.

Basidiomycetes.

Paxillus Osteopæon, *Massee* (*sp. nov.*). *Pileus* carnoso-lentus vel sub-coriaceus, planus vel depressus, margine arcte involuto sericeo glabratove, sordide albidus, 3–4 cm. diam. *Lamellæ* attenuato-decurrentes, confertæ, passim ramosæ anastomosantes. *Sporæ* subglobosæ, 4–5 μ diam. *Stipes* curtus, solidus, glaber, fuscescens.—*Kew Bulletin*, 1899, p. 56.

Mongolia. *Mrs. Kemp.*

Growing almost buried in loose sand ; said to be used extensively and with beneficial results in the treatment of diseased bones.

Tibet.

Basidiomycetes.

Clavaria fusiformis, *Sowerby*, *Eng. Fungi* (1799) t. 234.

S. Tibet. Yatung, *Hobson.*

Japan.

Uredineæ.

Puccinia Polygoni, *Pers. Syn.* (1801) p. 227 (P. Polygoni-amphibii, *Pers.*, l.c.).

Yesso. Abashiri, on *Polygonum sachalinense*, F. Schmidt, *Faurie*, 13,856.

India.

Basidiomycetes.

Pleurotus cretaceus, *Massee* (*sp. nov.*). *Pileus* carnoso-lentus, sicco rigidus, subrotundus, uno latere productus, margine involuto, plano-convexus, sæpe tumulosus, glaber, albidus, 6–9 cm. diam. *Lamellæ* confertæ, attenuato-decurrentes, postice anastomosantes, albidæ. *Sporæ* ovato-ellipticæ, hyalinæ, glabræ, 3 × 4 μ. *Stipes* excentricus, sæpe fere lateralis, glaber, albidus, 3–5 cm. longus, 2–3 cm. crassus, deorsum attenuatus, siccitate longitudinaliter rugulosus.

Punjab. Peshawar, on wood, *Watt*, 10339.

A very remarkable fungus, entirely creamy white. Very rigid when dry, and looking exactly like a plaster of Paris model. Allied to *P. sapidus*, Kalchbr. Dr. Watt's note accompanying the specimen is as follows : " It comes from Peshawar, where it is

known as 'Dhingri.' It is said to be sold by the shopkeepers much broken. The average rate at which it is sold is about Rs.2½ a seer. Before cooking it is soaked in fresh water for about eight hours. It then swells and becomes pulpy. It is said to be eaten with great relish and sent as a rarity in presents to friends all over India."

Volvaria woodrowiana, *Massee* (*sp. nov.*). *Pileus* carnosulus, campanulatus, dein explanatus, siccus, margine striatus, glaberrimus, griseo-lividus vel cinereus, 8–12 cm. diam. *Lamellæ* postice liberæ, ventricosæ, confertæ, salmonicolores, acie integra. *Sporæ* sphæroideo-ellipsoideæ, rubellæ, 10 × 8 μ. *Stipes* solidus, subæqualis, glaber, 9–15 cm. longus, 1 cm. circiter crassus, albus. *Volva* amplissima, libera, vaginalis, limbo lobata, albida.

BOMBAY. On the ground, Poona, *Woodrow*, 13.

Allied to *V. volvacea*, Bull.

Hydnum Gleadonii, *Massee* (*sp. nov.*). *Pilei* subcoriacei, sessiles, dimidiati, imbricati, strigoso-spongiosi, ex albo flavidi, margine flavi, 4–7 cm. lati. *Aculei* ex albo flavidi, usque ad 1 cm. longi, decurrentes, apice integri acuti. *Sporæ* hyalinæ, subglobosæ, 5 × 4 μ.

N. W. PROVINCES. On dead wood, Dehra Dun, *Gamble*, 26,475 (coll. F. Gleadon).

A very beautiful species, quite distinct in colour, and in the peculiar strigose covering of the pileus, which approaches in character that of *Trametes Hystrix*, Cooke.

Geaster lilacinus, *Massee* (*sp. nov.*). *Peridium* globosum, subumbonatum, 2 cm. diam.; exoperidium rigidum, carnosum, stellatim laciniatum, laciniis siccitate arcte involutis; endoperidium globoso-depressum, mammillatum, papyraceum, corrugatum, argenteum; ostiolum minutum; columella evanescens. *Sporæ* globosæ, brunneo-lilacinæ, verrucosæ, 10–12 μ diam.

N. W. PROVINCES. On the ground, Dehra Dun, *Gamble*, 26,465.

A small species somewhat resembling *G. hygrometricus*, Pers., but readily distinguished from this and every other known species by the very large size of the spores. In the mass the spores are dark brown with a lilac tinge.

HYPHOMYCETES.

Helminthosporium obclavatum, *Massee* (*sp. nov.*). *Hyphæ* rigidulæ, simplices, fasciculares, fuscæ, opacæ, sursum attenuatæ, 350–400 × 12–14 μ, maculas aterrimas velutinas formantes. *Conidia* elongato-obclavata, 7–11-septata, pallide olivacea, 80–120 × 18–20 μ.

N. W. PROVINCES. On branches of *Helicteres Isora*, Linn., Siwalik Hills, *Gamble*, 26,477.

Resembling *H. velutinum*, Link, in habit and colour, but differing in the larger pale conidia.

Coniosporium Arundinis, *Sacc. in Michelia* ii. (1882) p. 124.

N. W. PROVINCES. On culms of *Thysanolæna Agrostis*, Nees, Dehra Dun, *Gamble*, 26,566.

Trichosporium purpureum, *Massee* (*sp. nov.*). *Hyphæ* steriles copiosæ, repentes, pluries vage ramosæ, septatæ, hyalinæ, 4–5 μ crassæ. *Conidia* elliptica, levia, fusco-purpurea, 7 × 4 μ, in ramulis brevibus subglobosis inserta, acrogena.

N. W. Provinces. On dead wood; Dehra Dun, *Gamble*, 26,469.

Forming pulverulent patches 10–15 cm. across. Spores dark purple in the mass.

Trichosporium aterrimum, *Massee* (*sp. nov.*). *Hyphæ* steriles repentes, pallidæ, septatæ, 3·5–4 μ crassæ, vage ramosæ; hyphæ fertiles subsimplices, hyalinæ. *Conidia* elliptica, glabra, brunneo-olivacea, acrogena, 7–8 × 4 μ.

Punjab. On *Morus indica*, Linn., Changa Manga, *Gamble*, 26,476.

First attacking the cambium, which is destroyed, and then in dense jet-black pulverulent patches the fungus appears on both surfaces of the loose bark. In acting thus, the fungus eventually kills the tree.

Hymenopsis Cudraniæ, *Massee* (*sp. nov.*). *Sporodochia* convexula, superficialia, atra, 2–4 mm. diam., gregaria, epiphylla, maculas pallidas incrassatas formantia. *Conidia* ovoidea, glabra, olivacea, 3·5 × 2 μ, conidiophoris cylindricis suffulta.

N.W. Provinces. On living leaves of *Cudrania javanensis*, Trécul, Dehra Dun, *Gamble*, 26,473.

The fungus is a true parasite forming black irregular patches, crowded on thickened yellowish blotches 1–3 cm. across.

Sphacelia Oryzæ, *Massee* (*sp. nov.*). *Sporodochia* effusa, olivacea, suffulta hypostromate aurantiaco duro. *Conidiophora* brevia, simplicia, hyalina, bacillaria, 5–6 × 1·5 μ. *Conidia* solitaria, acrogena, globosa, verruculosa, sub lente pallide olivacea, 3·5–4 μ diam.

Assam. On the glumes of cultivated rice, North Lushai, *Watt*, 10,179.

This parasite is in all probability a conidial condition of some undescribed species of *Claviceps*.

Straits Settlements.

Basidiomycetes.

Mycena pelliculosa, *Sacc. Syll.* v. (1887) no. 295.
Perak. On rotten wood, *Ridley*, 13.

Mycena repertitia, *Massee* (*sp. nov.*). *Pileus* membranaceus, cylindricus, obtusus, glaber, striatus, striis e margine ad umbonem productis, albo-roseus, ad umbonem roseus, 5–8 mm. diam. *Lamellæ* subdistantes, angustæ, adnato-annexæ, albidæ. *Sporæ* ellipticæ, albo-roseæ, 7 × 4 μ. *Stipes* fistulosus, æqualis, albidus, glaber, 2–4 cm. longus, 2 mm. crassus.

PERAK. On rotten wood, *Ridley*, 21. Distinguished by the rose-coloured cylindrical pileus, striate from the margin to the minute umbo.

Allied to *M. codoniceps*, Cooke.

Mycena crassipes, *Massee* (*sp. nov.*). *Pileus* carnosulus, conico-campanulatus, dein expanso-umbonatus, striatus, glaber, e flavido pallidus albidusve, 2–3 cm. latus. *Lamellæ* confertæ, angustæ, postice annexæ, albidæ, ætate lutescentes, venoso-conjunctæ. *Sporæ* hyalinæ, ellipticæ, 8 × 5 μ. *Stipes* solidus, obesus, rigido-compactus, glaber, albo-flavus, sursum subattenuatus, 4–5 cm. longus, 7–8 mm. crassus.

SELANGOR. On stumps, *Ridley*, 65.

Remarkable for the thick, solid stem. Allied to *M. rugosa*, Fries.

Mycena gigantospora, *Massee* (*sp. nov.*). *Pileus* membranaceus, campanulatus, dein expanso-umbonatus, ad umbonem striatus, griseo-brunneus, umbone quam margine atriore, pruina grisea primo tectus, 2–3 cm. diam. *Lamellæ* subconfertæ, adnato-uncinatæ, cinereo-fuscæ. *Sporæ* ovatæ, hyalinæ, glabræ, 12–14 × 8–9 μ. *Stipes* fistulosus, glaber, æqualis, sursum pallidus, deorsum brunneus, basi albo-lanatus, 4–5 cm. longus, 3–4 mm. crassus.

PERAK. On the ground, *Ridley*, 3.

Distinguished from all known species by the brown colour of every part, and by the large spores.

Omphalia tenera, *Massee* (*sp. nov.*). *Pileus* submembranaceus, griseus, e convexo campanulato-umbilicatus, glaber, margine striatus, 5–9 mm. diam. *Lamellæ* distantes, decurrentes, albidæ. *Sporæ* globosæ, glabræ, hyalinæ, 7 μ diam. *Stipes* cavus, glaber, albidus, 3–3·5 cm. longus, 2 mm. crassus.

PERAK. On rotten wood, *Ridley*, 9.

Allied to *O. grisea*, Fries, from which it differs in the globose spores, and the umbilicate pileus.

Marasmius excentricus, *Massee* (*sp. nov.*). *Pileus* membranaceus, excentricus, convexo-campanulatus, plus minus umbilicatus, sulcatus, albus, margine sæpe crispatus, 3–5 cm. diam. *Lamellæ* valde distantes, ventricosæ, adnatæ, albidæ, acie integra. *Sporæ* ellipticæ, hyalinæ, glabræ, 7 × 5 μ. *Stipes* excentricus, albidus, basi lutescens, 1·5–2 cm. longus, 3 mm. crassus.

PERAK. Gregarious, growing on dead wood, *Ridley*, 18.

Whole fungus tough and elastic. Allied in many respects to *M. Hookeri*, Berk., but distinguished by the short, excentric stem.

Marasmius Rotula, *Fries, Epicr.* (1836) p. 385.

SELANGOR. On dead and fallen branches, *Ridley*, 74.

Marasmius epochnous, *Berk. & Curt. in Journ. Linn. Soc.* (*Bot.*) xiv. (1875) p. 41.

SELANGOR. On dead bark and wood, *Ridley*, 78.

Lentinus sericeus, *Massee* (*sp. nov.*). *Pileus* membranaceus, lentus, sericeus, nitens, cinereus, zonis fuscis evanidis præditus, dein fulvescens, margine pallidior interdum fimbriatus, 2–3 cm. diam. *Lamellæ* rigidæ, subconfertæ, brunneolæ, acie lacerato-dentata. *Sporæ* hyalinæ, glabræ, subglobosæ, 5-6 μ diam.

SELANGOR. On rotten wood, *Ridley*, 33.

The substance of the pileus is much thinner, more silky, and more shining than in *L. tricolor*, Berk., to which the present species is allied.

Schizophyllum flabellare, *Fries*, *Epicr.* (1838) p. 403.

SELANGOR. On rotten wood, *Ridley*, 90.

Claudopus griseus, *Massee* (*sp. nov.*). *Pileus* sessilis, carnoso-lentus, conchiformis ovatusve, interdum uno latere productus, griseus, sæpe corrugatus, 3–5 cm. diam. *Lamellæ* angustæ, distantes, venoso-connexæ, griseæ. *Sporæ* ellipsoideæ, asperulæ, albæ, roseo tinctæ, 8 × 5 μ. *Cistidia* numerosa, fusoidea, apice fuscidulo-granulata, 65–70 × 14–15 μ.

PERAK. On dead wood, *Ridley*, 11.

Superficially closely resembling *C. byssisedus*, Pers., but differing in the elliptic spores, and numerous cistidia.

Inocybe violacea, *Massee* (*sp. nov.*). *Pileus* carnosus, primo campanulatus, dein expansus et late umbonatus, squamulosus, margine fimbriato-villosus, violaceus, versus marginem pallidior, 1 cm. diam. *Lamellæ* confertæ, augustæ, postice sinuato-adnatæ, acie fimbriata, ex albido carneove roseo-tinctæ. *Sporæ* ellipticæ, glabræ, 7 × 4 μ, ochraceæ. *Cistidia* fusoidea. *Stipes* solidus, æqualis, subfibrillosus, carneo-roseus, apice albus furfuraceusque, 2–3 cm. longus, 2 mm. crassus.

PERAK. On lawns, *Ridley*, 2.

A pretty little species, allied to *Inocybe incarnata*, Bres.

Bolbitius longipes, *Massee* (*sp. nov.*). *Pileus* membranaceus, e conico-campanulato subexpansus, umbone leve prominente præditus, margine integer, glaber, læte brunneus vel luteo-fuscus, 1·5 cm. diam. *Lamellæ* subconfertæ, angustæ, postice uncinato-annexæ, aurantio-brunneæ. *Sporæ* oblongo-ovatæ, flavo-ferrugineæ glabræ, 17–18 × 11–12 μ. *Stipes* cavus, albus, glaber, æqualis, 7–8 cm. longus, 1·5–2 mm. crassus.

SELANGOR. On the ground, *Ridley*, 124.

Allied to *B. titubans*, Berk. Readily distinguished from every known species of *Bolbitius* by the even, acutely umbonate pileus, and slender, elongated stem.

Flammula ornata, *Massee* (*sp. nov.*). *Pileus* convexo-explanatus, umbonatus, flavus, squamulis secedentibus purpureis præditus, ætate glabrescens, 2–3 cm. diam. *Lamellæ* subconfertæ, postice sinuato-annexæ, flavæ, demum ferrugineo-maculatæ. *Sporæ* subglobosæ, intus minute granulosæ et 2–3 guttulis majoribus præditæ, 7 × 6 μ. *Stipes* solidus, glaber, basi attenuatus, 3 cm. longus, 4–5 mm. crassus.

SELANGOR. On the ground, *Ridley*, 23.

Not closely allied to any terrestrial species of *Flammula*. Distinguished by the purple squamules on the pileus.

Crepidotus Ridleyi, *Massee* (*sp. nov.*). *Pileus* submembranaceus, dimidiatus, reniformis, margine interdum lobatus, albidus, glaber, 4–7 mm. latus. *Lamellæ* ventricosæ, subconfertæ, brunneæ, acie integra. *Stipes* rudimentarius, albus. *Sporæ* ovato-oblongæ, glabræ, ochraceo-brunneæ, 5 × 3–4 μ.

SELANGOR. On a dead fern-rhachis, *Ridley*, 110.
Gregarious. Allied to *C. turbidulus*, Berk.

Psathyra cyclospora, *Massee* (*sp. nov.*). *Pileus* carnosulus, griseus, inexpansus conico-campanulatus, expansus subgibbosus, primo levis pruina albida conspersus, mox glabrescens, et dein margine pellucido striatus, 1·5–2 cm. diam. *Lamellæ* subconfertæ, ventricosæ, postice annexæ, pileo concolores, dein nigro-maculatæ. *Sporæ* nigro-fuscæ, subglobosæ, utrinque apiculatæ, glabræ, 12–14 μ. *Stipes* æqualis, fistulosus, glaber, albus, basi albo-fibrillosus, 4–5 cm. longus, 3 mm. crassus.
PERAK. On rotten wood, *Ridley*, 7.
Allied to *Psathyra semivestita*, Berk. & Broome.

Psathyra campanulata, *Massee* (*sp. nov.*). *Pileus* submembranaceus, campanulato-expansus, flavo-brunneus, disco brunneus, glaber, striatus, 2–3·5 cm. diam. *Lamellæ* confertæ, angustæ, postice attenuato-annexæ, e carneo-purpureo fuscescentes, acie integra. *Sporæ* ellipticæ, glabræ, carneo-fuscæ, 6–7 × 4 μ. *Stipes* fistulosus, sursum subattenuatus, albus, glaber, basi albo-tomentosus, 6–8 cm. longus, 4–5 mm. crassus.
SELANGOR. On the ground, *Ridley*, 108.
Gregarious. Allied to *P. conopilea*, Fries, but distinguished by the striate pileus and smaller spores.

Psathyrella albida, *Massee* (*sp. nov.*). *Pileus* membranaceus, digitaliformis, obtusus, striatus, glaber, albidus, 5–8 mm. latus. *Lamellæ* confertæ, postice uncinis decurrentes, incarnatæ, augustæ. *Sporæ* ellipsoideæ, pallide brunneæ, glabræ, 8 × 5 μ. *Stipes* fistulosus, hyalino-pellucidus, basi radicato-strigosus, 1·5 cm. longus, 1 mm. crassus.
SELANGOR. On rotten wood, *Ridley*, 55.
Growing in dense clusters. Allied to *P. disseminata*, Pers.

Coprinus coffeicola, *Massee* (*sp. nov.*). *Pileus* tenerrimus, campanulato-explanatus, griseus, immaturus furfuraceus, dein expansus subnudus, in rimas subfurcatas fissus, disco lividus subdepressus, 6–9 mm. diam. *Lamellæ* lineares, subconfertæ, a stipite remotæ, nigro-maculatæ, acie albida. *Sporæ* ellipsoideæ, nigro-brunneæ, glabræ, 8 × 5 μ. *Cistidea* fusoidea. *Stipes* filiformis, vix 1 mm. crassus, glaber, albidus, 3–4 cm. longus.
SELANGOR. On coffee pulp, *Ridley*, 67.
Numerous subglobose yellowish sclerotia, about 3 mm. in diameter, are present on the matrix, and these in all probability belong to the fungus; but as the organic union between the two was not observed, this is not quite certain. Allied to *C. plicatilis*, Fries; differing in the smaller spores and more furfuraceous pileus.

Coprinus leviceps, *Massee* (*sp. nov.*). *Pileus* membranaceus, levis, glaber, convexo-campanulatus dein explanatus, umbilicatus, cinereus, 1·5–2·5 cm. diam. *Lamellæ* confertæ, augustissimæ, postice rotundato-liberæ. *Sporæ* globosæ, atro-brunneæ, glabræ, 7–8 μ diam. *Cistidia* non visa. *Stipes* fistulosus, albus, glaber, 3–4 cm. longus, 3 mm. crassus.
PERAK. Densely gregarious on a dead stump of *Areca*, *Ridley*, 17.

Allied to *C. deliquescens*, Bull., but readily distinguished from this and every other known species of *Coprinus* by the perfectly even pileus and globose spores.

Lenzites platyphylla, *Lév. in Ann. Sci. Nat.*, sér. 3, ii. (1844) p. 173.
SELANGOR. On dead wood, *Ridley*, 91.

Polyporus albellus, *Massee* (*sp. nov.*). *Pileus* dimidiatus, semi-orbicularis seu reniformis, tenuis, applanatus, glaber, margine expanso interdum lobatus, albidus, 4–5 cm. diam. *Pori* ampli, oblongi aut angulati, stramineo-albi, postice decurrentes. *Stipes* lateralis, brevis, subæqualis, concolor, 1 cm. longus.
SELANGOR. On dead wood, *Ridley*, 80.
Allied to *P. Gunnii*, Berk.

Polyporus arcularius, *Fries, Syst. Myc.*, i. (1821) p. 342.
SELANGOR. On rotten wood, *Ridley*, 31.

Polystictus membranaceus, *Sacc., Syll.*, vi. (1888) no. 287.
SELANGOR. On dead wood, *Ridley*, 92.

Polystictus latus, *Sacc., Syll.*, vi. (1888) no. 291.
SELANGOR. On rotten wood, *Ridley*, 93.

Polystictus licmophorus, *Massee* (*sp. nov.*). *Pileus* coriaceo-membranaceus, convexo-applanatus, levis vel leviter lineis concentricis zonatus, semi-orbicularis, attenuato-substipitatus, minutissime velutino-villosus, dein glaber, e cinnamomeo pallidus, 1·5–2 cm. diam. *Pori* minutissimi, subrotundi, albi, vel in ætate vel triti lividi. *Sporæ* hyalinæ, ellipsoideæ, 6 × 3 μ.
SINGAPORE. On rotton wood, Botanic Gardens, *Ridley*, 55.
Allied to *P. squamiformis*, Berk., but differing in the smaller spores and paler colour of the pileus.

Hydnum crinigerum, *Massee* (*sp. nov.*). *Subiculus* resupinatus, tenuis, ochraceus, albo-flocculosus, 1–2 cm. latus. *Aculei* cylindraceo-filiformes, elongati, acutiusculi, pallide sulphurei, exsiccati albidi. *Sporæ* subglobosæ, verruculosæ, hyalinæ, 5–6 μ diam.
SELANGOR. On dead bark, *Ridley*, 107.
Forming scattered patches; the spines up to 6 mm. long, slender and hair-like, but not crowded.

Hydnum tapienum, *Massee* (*sp. nov.*). *Pileus* sessilis, imbricatus, carnosus, lentus, siccatate rigidus margine forte involutus, subreniformis vel flabelliformis, virgatus, 5–8 cm. diam. *Aculei* conferti, acutiusculi, glabri vel minutissime asperuli, pallide ochracei, circa 3 mm. longi. *Sporæ* globosæ, hyalinæ, glabræ, 5–6 μ diam.
SELANGOR. On fallen trunks, *Ridley*, 75.
Allied to *H. flavum*, Berk.

Stereum aterrimum, *Massee* (*sp. nov.*). *Pileoli* vel simplices vel 2–4 lateraliter connati et imbricatim dispositi, puncta laterali affixi, 3–5 cm. circiter diam., conchiformes, superne radiato-rugosi, rigidissimi, fuligineo-rufescentes, dein nigricantes. *Hymenium* scabriusculum, nigrum, rimosum. *Sporæ* oblongo-ellipticæ, hyalinæ, 7 × 4 μ.

SINGAPORE. On dead wood, Botanic Gardens, *Ridley*, 48.

Readily distinguished by its extreme rigidity, and by the black colour of every part.

Cladoderris cartilaginea, *Massee* (*sp. nov.*). *Pileus* coriaceo-lentus, erectus, flabelliformis vel obovatus, margine repandus vel lobatus, levis, glaber, fusco-brunneus, expallens, 5–8 cm. altus, 3–5 cm. latus. Hymenium glabrum, longitudinaliter radiato-rugosum, concolor. *Sporæ* ellipsoideæ, hyalinæ, basi oblique apiculatæ, 10 × 5 – 5·5 μ.

SINGAPORE. On decayed wood, buried in the ground, Botanic Gardens, *Ridley*, 47.

Distinguished by the thin substance of the pileus, which is cartilaginous when dry.

Clavaria Ridleyi, *Massee* (*sp. nov.*). *Caulis* crassus, brevis, 1 cm. circiter diam., umbrinus, solidus ; rami subconferti, teretes, leves, dichotomo-ramulosi, umbrino-rufescentes, apicibus lunulato-furcatis. *Caro* alba. *Sporæ* hyalinæ, subglobosæ, glabræ, 7 × 8 μ ; basidia clavata, 35 × 12 μ.

PERAK. On the ground at the base of trunks, *Ridley*, 19.

A very marked species, characterised by the short, stout trunk, and umber colour.

Clavaria Candelabra, *Massee* (*sp. nov.*). *Caulis* tenuis, 1–2 cm. longus, 2 mm. crassus, basi albo-villosus ; rami 2–4, ramulos rare gerentes ; ramuli ultimi inæquales, fere verticillati, vix vel haud caule tenuiores, in sicco sulcato-rugosi ; rami ramulique juniores pallide lutei, dein flavo-rufescentes. *Sporæ* hyalinæ, glabræ, subglobosæ, 4–5·5 μ, diam.

SELANGOR. On rotten wood, *Ridley*, 37.

Allied to *C. epichnoa*, Fries.

Favolus scaber, *Berk. et Broome in Journ. Linn. Soc.*, xiv. (1875) p. 57.

SELANGOR. On dead wood, *Ridley*, 30.

Laschia cæspitosa, Sacc., Syll. vi. (1888) no. 407.

SELANGOR. On dead wood, *Ridley*, 32.

Tremellodon aurantiacum, *Massee* (*sp. nov.*). *Pileus* gelatinoso-cartilagineus, flabelliformis, longe stipitatus, aurantiacus, 1–2 cm. latus. *Aculei* minuti, subulati, acutissimi. *Sporæ* subglobosæ, hyalinæ, 6–7 μ diam.

SELANGOR. On rotten wood, *Ridley*, 72.

Differs from all known species in the bright orange colour of every part. It bears a very close superficial resemblance to *Guepinia spathularia*, Fries. The spines on the hymenium are very minute, and almost inconspicuous when dry.

Tremella picea, *Massee* (*sp. nov.*). *Hymenophora* cartilagineo-gelatinosa, corrugata, sessilia, brunneo-nigra, 3–4 cm. lata. *Basidia* obovata, cruciatim partita. *Sporæ* hyalinæ, ellipsoideæ, leviter curvatæ, 11–12 × 3–4 μ.

SELANGOR. On dead wood, *Ridley*, 27.

Allied to *T. corrugata*, Schweinitz ; differing in the absence of a purple tinge, and in not becoming squamulose when dry.

Hirneola porphyrea, *Fries, Fung. Natal.* (1848) p. 27.
SELANGOR. On rotten wood, *Ridley*, 20.

Geaster Maurus, *Massee* (*sp. nov.*). *Peridium* globosum, umbonatum, umbrinum, stratis duobus distinctis compositum, exteriore rigido carnoso stellatim laciniato, interiore globoso-depresso papyraceo ; ostiolum fimbriatum. *Gleba* aterrima, columella evanescente. *Sporæ* globosæ, nigro-fuscæ, echinulatæ, 3 μ diam.
SINGAPORE. On the ground, *Ridley*, 30.
Characterised by the black gleba.

Tulostoma Ridleyi, *Massee* (*sp. nov.*). *Peridium* stipitatum, depresso-globosum, verrucis pyramidalibus brunneis exasperatum, 1·5–2 cm. latum ; os ad apicem mammæ positum, mox lacerato-evanescens. *Stipes* cavus, æqualis, basi bulbosus, bulbo apice marginato, squamulosus, dein glabrescens, 3 cm. longus 4 mm. crassus. *Gleba* læte ochracea. *Sporæ* globosæ, flavidæ, asperulæ, 6–7 μ diam.
PERAK. On the ground near stumps, *Ridley*, 8.
Allied to *T. exasperatum*, Mont.

ASCOMYCETES.

Cordyceps Ridleyi, *Massee* (*sp. nov.*). *Stroma* erectum, cylindricum, 3–4 mm. altum, in stipitem filiformem deorsum abrupte attenuatum, supra in stylum longiusculum productum, griseo-brunneum, scabriusculum. *Perithecia* immersa, ovoidea, 250 μ diam., ostiolo papillato ornata. *Asci* cylindrici, stipitati, apice capitati, 150 × 7 μ. *Sporæ* octonæ, filiformes, basi et apice acutiusculæ, primo dense guttulatæ, dein pluri-septatæ, 110 × 1·5 μ.
SELANGOR. On an ant, *Ridley*, 89.
Springing in considerable numbers from the head, thorax, abdomen, and limbs, and some imperfect stromata also occur on the antennæ. Allied to *C. stylophora*, Berk. & Broome.

Cordyceps lignicola, *Massee* (*sp. nov.*). *Capitulum* cylindraceo-clavatum, obtusum, durum, nigrum, 2–3 cm. longum, 3 mm. latum. in stipitem cylindricum æquilongum nigrum deorsum abrupte attenuatum. *Perithecia* ovata, immersa, ostiolis minutissimis prominulis. *Asci* cylindracei, longissimi, octospori. *Sporæ* aciculares, hyalinæ, multiseptatæ, 180 × 2 μ.
SELANGOR. On rotten wood, *Ridley*, 41.
A very interesting form, the only known species of *Cordyceps* growing on wood, the others being either entomogenous or mycogenous : stem slender, glabrous, longer than the fertile portion.

Hypocrella scutata, *Sacc. in Michelia* i. (1879) p. 580.
PERAK. On living leaves of an undetermined tree, *Ridley*, 16.
The species was founded on specimens from Singapore growing on the living leaves of *Myristica* sp.

Hypocrella Panici, *Massee* (*sp. nov.*). *Stroma* carnosulum, elongatum, nigrum. *Perithecia* ovoidea, in stromate immersa,

ostiolo papillato. *Asci* cylindraceo-clavati, longe stipitati, 150 × 6 μ, octospori. *Sporæ* filiformes, hyalinæ, multiseptatæ, 100 × 1·5 μ.

SELANGOR. Distorting the lateral branches of a species of *Panicum*, *Ridley*, 88.

The stroma is 2–3 cm. long, curved, half encircling the branch. Allied to *H. semiamplexa*, Sacc.

Hypocrella Zingiberis, *Massee* (*sp. nov.*). *Stroma* carnosum, pulvinatum, aurantiacum dein pallescens, 3–4 mm. diam. *Perithecia* stromate immersa. *Asci* anguste cylindraceo-clavati, 140–150 × 8 μ, octospori. *Sporæ* filiformes, ascis subæquales, multiseptatæ, 120 × 1·5 μ.

PERAK. On petioles of a *Zingiber*, *Ridley*, 10.

Allied to *H. Bambusæ*, Sacc.; differing in the longer spores and the bright orange-coloured stroma.

Xylaria hypsipoda, *Massee* (*sp. nov.*). *Stroma* globosum, nigrum, intus suberosum, pallidum, stipitatum, 3–5 mm. diam. *Stipes* simplex, filiformis, rectus vel subflexuosus, sursum patenti-hirsutus, 6–8 cm. longus, 1 mm. crassus. *Asci* elongato-clavati, octospori. *Sporæ* 1-seriatæ, ellipsoideæ, basi et apice subacutæ, brunneæ, 12 × 6–7 μ.

SINGAPORE. Gregarious on dead leaves, Bukit Manda, *Ridley*, 34.

Xylaria aspera, *Massee* (*sp. nov.*). *Capitulum* clavatum vel obovatum, obtusum, nigrum, asperatum, 1–1·5 cm. altum, in stipitem curtum deorsum attenuatum. *Perithecia* peripherica, immersa, globosa, ostiolis minutis exsertis. *Asci* cylindracei, substipitati, 125 × 7 μ. *Sporæ* octonæ, oblique monostichæ, ellipticæ, cymbiformes, nigræ, 10 × 5 μ.

SELANGOR. On rotten wood, *Ridley*, 71.

Clubs sometimes deformed; distinguished by the corrugated surface and the small spores.

Xylaria acicularis, *Cooke in Grevillea* xi. (1883) p. 85.
SELANGOR. On dead wood, *Ridley*, 63.

Xylaria ianthino-velutina, *Mont.*, *Syll. Crypt.* (1856) no. 690.
PERAK. On rotten wood, Larut, *King*, 2252.
Hitherto only recorded from South America.

Diatrype excitans, *Cooke in Ann. N. York Acad.* i. (1878) p. 185.
SELANGOR. On dead wood, *Ridley*, 44.

Peziza radiculosa, *Berk. & Broome in Journ. Linn. Soc.* (*Bot.*) xiv. (1875) p. 103.

PERAK. On the ground, *Ridley*, 12.

A very fine and distinct species, only previously recorded from Ceylon.

Peziza tricholoma, *Mont. in Ann. Sci. Nat.* ii. (1834) 77, t. 4, fig. 2.

SELANGOR. On dead wood, *Ridley*, 36.

When quite young the outside and margin bristles with long spine-like hairs, each composed of a fascicle of hyphæ. As the plant becomes mature, the majority of these hairs fall away, and in old specimens the surface is often quite glabrous. The asci are remarkable for being abruptly narrowed at the base into a long, very slender pedicel. *P. Hindsii*, Berk., is in every respect identical with the present species.

Peziza martialis, *Massee* (*sp. nov.*). *Ascomata* gregaria, subsessilia, convexa dein applanata, 2·5–3·5 cm. lata, extus puberula pallida, disco obscure coccinea. *Asci* cylindrici, deorsum in stipitem elongatum attenuati, 375–380 × 20–22 μ, octospori. *Sporæ* ellipticæ, hyalinæ, glabræ, oblique monostichæ, 30 × 18 μ. *Paraphyses* filiformes, apice clavatæ, septatæ.

SELANGOR. On the ground, *Ridley*, 48.

Distinguished amongst the crimson species of *Peziza* by the large size of the asci and spores. Hypothecium and excipulum composed of slender interwoven hyphæ. Asci not tinged blue by iodine.

Peziza tomentosa, *Massee* (*sp. nov.*). *Ascomata* sessilia, convexa dein explanata, subcarnosa, extus albo-tomentosa, disco flavida, 1–1·5 cm. lata. *Asci* cylindracei, obtusati, deorsum in stipitem obliquum attenuati, iodo non tincti, ostospori, 150–160 × 13–14 μ. *Sporæ* ellipticæ, utrinque subacutæ, hyalinæ, glabræ, 15–16 × 10 μ. *Paraphyses* filiformes, septatæ, apice subclavatæ.

SELANGOR. On the ground, *Ridley*, 70.

Allied to *P. fibrillosa*, Curr.

Mollisia cinnabarina, *Massee* (*sp. nov.*). *Ascomata* sessilia, subcarnosa, concavo-explanata, extus puberula dein glabra, rugulosa, extus pallide rosea, disco cinnabarina, marginibus elevatis tumidis, 5–8 mm. lata. *Asci* cylindracei, obtusati, iodo haud tincti, octospori, 160 × 11 μ. *Sporæ* ellipticæ, utrinque obtusæ, hyalinæ, glabræ, obliquæ, monostichæ, 18 × 9-10 μ. *Paraphyses* numerosæ, guttulatæ, æquales, 3 μ diam.

SELANGOR. On dead branches, *Ridley*, 95.

Allied to *M. albo-flava*, Massee, while resembling *Geopyxis coccinea* in colour.

Mollisia albo-flava, *Massee* (*sp. nov.*). *Ascomata* sessilia, carnosa, explanato-concava, glabra, extus albida, margine sæpissime undulato-repando pallida, disco citrina, 4–7 mm. lata. *Asci* cylindraceo-fusoidei, obtusi, iodo haud tincti, 100–120 × 9–10 μ, octospori. *Sporæ* hyalinæ, ellipsoideæ, 9 × 6 μ. *Paraphyses* numerosæ, apice subincrassatæ, filiformes.

SELANGOR. On a dead branch, *Ridley*, 62.

Scattered or gregarious ; allied to *M. personata*, Sacc.

Mollisia rosea, *Massee* (*sp. nov.*) *Ascomata* carnosa, ex hemispherico expansa, sessilia vel subradicato-producta, extus leviter tomentosa, albida, 5–10 mm. lata, disco e pulchre roseo depallente. *Asci* cylindracei, iodo haud tincti, basi non vel vix attenuati, 120 × 12 μ. *Sporæ* ellipticæ, utrinque obtusatæ, hyalinæ, glabræ, biguttulatæ, 14 × 8 μ.

SELANGOR. On dead branches, *Ridley*, 82.

Readily distinguished amongst the known species by the clear, rose-coloured disc. Allied to the species above, *M. albo-flava*, Massee.

Trichopeziza chrysotricha, *Sacc., Syll.* viii. (1889) p. 411.
SELANGOR. On rotten twigs, *Ridley*, 47.

HYPHOMYCETES.

Isaria Sphingum, *Schweinitz, Syn. Fung. Car.* (1822) p. 126.
SELANGOR. Parasitic on a green elephant hawk-moth, *Ridley*, 59.

PHILIPPINE ISLANDS.

BASIDIOMYCETES.

Lenzites applanata, *Fries, Epicr.* (1836) p. 644.
LUZON, Manilla. On dead wood, *Loher*.

Fomes Senex, *Sacc., Syll.* vi. (1888) p. 164.
LUZON. On dead wood, Loher.

Polystictus sanguineus, *Fries in Nov. Act. Soc. Sc. Upsal.* i. (1851) p. 74.
LUZON. On rotten wood, *Loher*.

Polystictus Xanthopus, *Fries in Nov. Act. Soc. Sc. Upsal.* i. (1851) p. 74.
LUZON. On rotten wood, *Loher*.

Hexagonia apiaria, *Pers. in Freyc., Voy.* (1826) p. 160, t. 2, fig. 5.
LUZON. Manilla. On dead wood, Loher.

Hexagonia rigida, *Berk. in Journ. Linn. Soc.* (*Bot.*) xvi. (1878) p. 54.
LUZON. Manila. On rotten wood, *Loher*.

Favolus purpureus, *Massee* (*sp. nov.*). *Pileus* carnosus, e campanulato expansus, orbicularis, ex involuto expansus, interdum margine undulatus, purpureus, glaber, 1–2 cm. latus. *Alveoli* e rotundato subhexagoni, radiatim elongati, majusculi, purpurei, in sicco fulvescentes. *Stipes* centralis, sursum attenuatus, glaber, purpureus, basi fuscescens, 3–4 cm. longus. *Caro* flavida. *Sporæ* hyalinæ, elongatæ, glabræ, biguttulatæ, 8 × 4 μ.
LUZON. On the ground, *Loher*.
Gregarious. Recognised by the purple colour of every part.

USTILAGINEÆ.

Ustilago virens, *Cooke in Grevillea* vii. (1878) p. 15.
LUZON. Manila. In ovaries of *Oryza sativa*, Linn., *Loher*.

HYPHOMYCETES.

Isaria Sphingum, *Schweinitz, Syn. Fung. Car.* (1822) p. 126.
LUZON. Manila. On undetermined larvæ, *Loher*.

British New Guinea.

Ascomycetes.

Phyllachora ulcerata, *Massee* (*sp. nov.*) *Stroma* superficiali-prominens, tuberculiforme, e loculis mammillatum, atrum, 3–5 mm. latum. *Loculi* ovati, minuti, in stromate nidulantes. *Asci* cylindraceo-pedicellati, 65–70 × 10 μ, octospori. *Sporæ* distichæ, hyalinæ, ovato-oblongæ, glabræ, 10–12 × 5 μ. *Paraphyses* ramosæ, filiformes.

On the upper surface of a coriaceous leaf, *Bailey*.

Allied to *P. incarcerata*, Sacc.

Aulographum maximum, *Massee* (*sp. nov.*) *Perithecia* gregaria, lineari-elongata, nigra, rima augustissima dehiscentia. *Asci* cylindraceo-clavati, aparaphysati, octospori, 90–100 × 12–14 μ. *Sporæ* hyalinæ, allantoideæ, curvulæ, circa apicem 1–septatæ, 17–18 × 5–6 μ.

On culms of *Imperata arundinacea*, Cyr., *Bailey*.

Allied to *A. culmigenum*, Sacc., but distinguished by the much larger perithecia and spores.

Queensland.

Ascomycetes.

Phyllosticta flavidula, *Sacc. in Michelia*, i. (1879) p. 521.
Brisbane. On living leaves of a *Callistemon*, *Bailey*, 1115.

Stigmatea seminata, *Sacc.*, *Syll.*, i. (1882) no. 543.
Brisbane. On the pods of *Desmodium parvifolium*, DC., *Bailey*, 1117.

Sphæropsideæ.

Glœosporium kurzeanum, *Niessl in Rabenh. Fung. Eur. Exsicc.*, no. 2471.
Brisbane. On living leaves of *Lathyrus latifolius*, Linn., *Bailey*, 1118.

Tasmania.

Basidiomycetes.

Clitocybe Tuba, *Fries*, *Epicr.* (1836) p. 72.
Rodway, 293.

Collybia Eucalypti, *Massee* (*sp. nov.*). *Pileus* carnosus, tenuis, e convexo explanatus, interdum subumbonatus, margine imprimis incurvus, levis, glaber, eburneus, disco griseo-tinctus, 2–3 cm.

latus. *Lamellæ* annexæ, demum liberæ, confertæ, albidæ, acie serrulata. *Stipes* fistulosus, sursum attenuatus, incurvatus, fibrosus, pallide brunneus, 4–6 cm. longus. *Sporæ* hyalinæ, obovatæ, 5–6 × 3–4 μ.

On a *Eucalyptus* trunk, *Rodway*, 73.

Clustered, tough. In old, large specimens the whole surface of pileus and stem is marbled with glands or exudations, but not so in other cases. (*Rodway*).

Hygrophorus Rodwayi, *Massee* (*sp. nov.*). *Pileus* carnosus, e convexo plano-umbonatus, vel gibbosus, viscidulus, albellus, vel cremoricolor, glaber, 4–5 cm. latus. *Lamellæ* distantes, ad latera venosæ, longe decurrentes, ex albido pileo concolores. *Stipes* solidus, sursum incrassatus, concolor, subfibrilloso-glabrescens, 5 cm. longus, apice 7–10 mm. crassus. *Sporæ* subglobosæ, rugulosæ, apiculatæ, hyalinæ, 7–8 μ diam.

On the ground, *Rodway*, 137.

Allied to *H. eburneus*, Bull., but differing in the structure of the stem.

Xerotus atrovirens, *Massee* (*sp. nov.*). *Pileus* membranaceus, resupinatus, pruinosus, atro-virens, 5 mm. latus. *Lamellæ* angustæ, anastomosantes, pileo concolores, acie pallida. *Sporæ* hyalinæ, globosæ, 4 μ diam. *Stipes* excentricus, incurvus, pruinosus, 2–3 mm. longus.

On dead twigs of a *Billardiera*, *Rodway*, 610.

Allied to *X. Berterii*, Mont., but distinguished by the blackish green tinge of every part.

Pluteus phæus, *Massee* (*sp. nov.*). *Pileus* tenuis, e convexo expansus, obtuse umbonatus, glaber, atro-cyaneus, 2–4 cm. latus. *Lamellæ* confertæ, postice rotundato-liberæ, e cæsio incarnato-griseæ. *Sporæ* angulatæ, 8–10 μ diam. *Stipes* farctus, flexuosus, superne subdilatatus, chalybeus, basi excepta glaber, 5–6 cm. longus, 2–3 mm. crassus.

On dead wood, *Rodway*, 562.

Resembling *Leptonia bizzozeriana*, Sacc., which differs from the present in the scurfy pileus and elliptic spores.

Leptonia obscura, *Massee* (*sp. nov.*). *Pileus* carnosulus, e convexo plano-umbonatus, margine primo involutus, nigro-chalybeus, junior totus dense villosus, dein bene evolutus squamulis parvulis obsitus, 2–4 cm. latus. *Lamellæ* subconfertæ, latæ, adnatæ, fuliginosæ, demum carneo tinctæ. *Sporæ* angulosæ, apiculatæ, 9–10 μ diam. *Stipes* farctus, æqualis, concolor, 5–6 cm. longus, 3 mm. crassus.

On the ground in woods, *Rodway*, 307.

Affinity with *L. chalybea*, Fries.

Flammula Aldridgei, *Massee in Grevillea*, xx. (1891) p. 25.

Rodway, 45.

This species was incorrectly referred to *Flammula veluticeps*, Cooke and Mass., by McAlpine.

Psilocybe œdipus, *Massee* (*sp. nov.*). *Pileus* carnosus, e convexo plano-depressus, margine levis, glaber, siccus, obscure rufo-brunneus, 3–5 cm. latus. *Lamellæ* confertæ, postice ventricosæ,

e flavo-brunneo fuscescentes. *Sporæ* ellipsoideæ, fuligineæ, 6–7 × 4 μ. *Stipes* fistulosus, æqualis, basi bulbosus, lamellis concolor, 4–5 cm. longus.

On the ground, Hobart, *Rodway*, 320.

Allied to *P. sarcocephala*, Fries.

Boletus Rodwayi, *Massee* (*sp. nov.*). *Pileus* pulvinatus, dein convexo-planus, viscosus, glaber, vinosus, margine flavescens, 3–5 cm. latus. *Caro* alba, sapore grato. *Tubuli* circa stipitem depressi, elongati; pori angulati, ·05 mm. lati, incarnati vel subrubentes. *Sporæ* cylindrico-fusoideæ, uniguttulatæ, rubro-brunnescentes, 9–10 × 4 μ. *Stipes* solidus, subæqualis, albidus, basi attenuatus, curvatus vel subflexuosus, 7–8 cm. longus, 1–1·5 cm. crassus.

On the ground, *Rodway*, 266, with a figure.

Distinguished amongst species having flesh-coloured tubes by the viscid pileus and somewhat slender, equal, incurved stem. Flesh of pileus comparatively thin.

Polyporus lacteus, *Fries*, *Syst. Myc.*, i. (1821) p. 59.
On wood, *Rodway*, 194.

Polyporus tasmanicus, *Massee* (*sp. nov.*). *Pileus* carnosus, turbinatus, plano-depressus, ochroleucus vel pallide alutaceus, glaber, 6–7 cm. latus. *Pori* breves, inæquales, subrhomboidei, straminei, marginibus fimbriati, circa 1 mm. lati. *Caro* alba, lenta. *Sporæ* hyalinæ, leves, oblongo-ellipsoideæ, 10–13 × 6–7 μ. *Stipes* centralis, solidus, subreticulatus, 2–2·5 × 1·5 cm.

On the ground, *Rodway*, 138.

Nearest affinity with *P. ovinus*, Fries.

Hydnum Caput-medusæ, *Fries*, *Syst. Myc.* i. (1821) p. 409.
On dead wood, *Rodway*, 234.

A small form, 2–3 cm. in diameter, and in this respect differing from the typical European form, with which it, however, agrees in all essential features.

Hymenochæte Mougeotii, *Massee in Journ. Linn. Soc.* (*Bot.*) xxvii. (1891) p. 111.
On dead bark, *Rodway*, 448.

Hymenochæte corrugata, *Lév. in Ann. Sci. Nat.* sér. 2, v. (1846) p. 152.
On dead wood, *Rodway*, 337.

Hymenochæte tenuissima, *Berk. in Journ. Linn. Soc.* (*Bot.*) x. (1869) p. 333.
On dead wood, *Rodway*, 336.

Peniophora Berkeleyi, *Cooke in Grevillea*, viii. (1879) p. 20.
On dead bark, *Rodway*, 542.

Myxomycidium, *Massee* (*nov. gen.*). *Receptacula* pendula, stipitata, tremelloso-gelatinosa, hyalina. *Basidia* clavata, sterigmatibus quaternis. *Sporæ* continuæ, hyalinæ.

A remarkable genus without very evident affinities. The watery, gelatinous substance suggests the Tremellineæ, but the narrowly clavate basidia, surmounted by four slender sterigmata,

are opposed to this view. The general form of the sporophore is that of the Clavarieæ, where the gelatinous consistency is unknown.

Myxomycidium pendulum, *Massee* (*sp. nov.*). *Receptacula* pendula, aquoso-gelatinosa, stipitata, lanceolata, apice acuta, hyalina vel basi ochraceo tincta, 1–1·5 cm. longa. *Basidia* clavata, 25–28 × 6–7 μ. *Sporæ* ovatæ, inæquilaterales, hyalinæ, glabræ, 8–9 × 6 μ.

On rotten wood, *Rodway*, 605.

"Always pendulous and in consistency much more watery than any *Clavaria* we have." (*Rodway.*)

Solenia candida, *Pers.*, *Disp.* (1797), p. 6.

On rotten wood, *Rodway*, 587.

In some parts of the specimen the plants are closely compacted laterally, and indistinguishable from *Poria*.

Kneiffia Wrightii, *Berk. & Curt. in Journ. Linn. Soc.* (*Bot.*) x. (1869) p. 327.

On dead wood, *Rodway*, 468.

Tremella vinosa, *Massee* (*sp. nov.*). *Receptaculum* gelatinosum, molle, gyroso-plicatum, glabrum, vinosum, 1–2 cm. latum. *Basidia* globosa, 4-sterigmatica. *Sporæ* subglobosæ, hyalinæ, glabræ, 10 μ.

On dead wood, *Rodway*, 594.

Allied to *T. corrugata*, Schweinitz.

Gyrocephalus luteus, *Massee* (*sp. nov.*). *Receptacula* gelatinosa, stipitata, spathulato-convoluta, flavida, 1–1·5 cm. lata. *Basidia* globosa, cruciatim partita, sterigmatibus quaternis elongatis coronata. *Sporæ* hyalinæ, continuæ, glabræ, oblongo-curvatæ 12–13 × 4–4·5 μ.

On dead wood, *Rodway*, 598.

Secotium Gunnii, *Berk. ex Cooke*, *Hœnäb. Austr. Fung.* (1892) p. 221.

On the ground, *Rodway*, 291.

Tylostoma mammosum, *Fries*, *Syst. Myc.* iii. (1829) p. 42.

On the ground, *Rodway*, 535.

Diploderma glaucum, *Cooke & Massee in Grevillea*, xv. (1887) p. 99.

In the ground on dry hill-sides, *Rodway*, 534.

Mr. Rodway points out that the central woody nucleus is absent in this species, which thus lacks one of the essential features of the genus *Diploderma*.

Hymenogaster nanus, *Massee et Rodway* (*sp. nov.*). *Peridium* globosum, gibbosum, vix viscidum, 1·5 cm. latum, griseo-brunneum, a gleba facile separabile; cellulæ e basi sterili radiantes; septa crassa, brunnea. *Sporæ* ellipticæ, utrinque subacutæ, verruculosæ, flavo-brunneæ, pellucidæ, 14–15 × 8 μ.

Underground, Hobart, *Rodway*, 609.

"I have only found the one specimen. It seems very close to forms of *Secotium Gunnii*? but the spores are brown and twice as large." (*Rodway*).

Hysterangium neglectum, *Massee et Rodway* (*sp. nov.*). *Peridium* subglobosum, extus pallidum, rugulosum, nec a gleba separabile, 1–1·5 cm. latum. *Gleba* subgelatinosa, obscure brunnea, absque basi sterili; cellulæ irregulares, gyrosæ. *Sporæ* ellipsoideo-oblongæ, utrinque obtusæ, rugulosæ, pallide flavo-brunneæ, 12–13 × 8 μ.

Underground, Hobart, *Rodway*, 614.

Allied to *H. affine*, Massee & Rodway.

Ascomycetes.

Hypocrea rufa, *Fries*, *Summa Veg. Scand.* (1849) p. 383.
On rotten wood, *Rodway*, 555.

Xylaria cupressiformis, *Becc. in Erb. Critt. Ital.* no. 1278.
On dead bark, *Rodway*, 554.

Hypoxylon annulatum, *Mont.*, *Syll. Crypt.* (1856) p. 213.
On dead wood, *Rodway*, 224.

Nectria tephrothele, *Berk. in Hook. f., Flor. Tasm.* ii. (1860) p. 278.
Parasitic on *Hypoxylon annulatum*, Mont., *Rodway*, 224.

Parodiella Banksiæ, *Sacc. et Bizz. in Sacc., Syll.* ix. (1895), no. 1723.
On the under surface of living leaves of *Banksia marginata*, Cav., *Rodway*, 540.

Coccomyces trigonus, *Karsten., Myc. Fenn.* i. (1871) p. 257.
On dead leaf of *Eucalyptus obliqua*, L'Hérit., *Rodway*, 542.

Lembosia geographica, *Massee* (*sp. nov.*). *Perithecia* dense gregaria, in maculis rotundis nigricantibus nidulantia, elongato-flexuosa, contextu parenchymatica. *Asci* subclavati, breviter pedicellati, octospori. *Sporæ* oblongæ, medio 1-septatæ, ad septum demum subconstrictæ, flavo-brunneæ, 20 × 6–7 μ.
On phyllodes of *Eucalyptus obliqua*, L'Hérit., *Rodway*, 541.
Spots black, usually circular, averaging 5 mm. across; often running into each other and forming irregular patches.

Lasiosphæria ovina, *Cesati et De Notar., Schema Sfer. Ital.* (1861) p. 229.
On bark, along with *Sordaria caudata*, Sacc., *Rodway*, 584.

Sordaria caudata, *Sacc., Syll.* i. (1882) no. 858.
On bark, along with *Lasiosphæria ovina*, Cesati & De Notar., *Rodway*, 584.

Dothidiella inæqualis, *Cooke in Grevillea*, xx. (1891) p. 5.
On leaves of *Eucalyptus obliqua*, L'Hérit., *Rodway*, 538.

Exoascus deformans, *Fuckel*, *Symb. Mycol.* (1869) p. 252.
On living peach leaves, *Rodway*, 455.
"Seems to differ in habit from the described plant by always growing on the upper surface of the leaf, and in the ascigerous stage being immediately followed by conidia that form a close, pale brown, velvety surface." (*Rodway*).

Barlæa miltina, *Sacc.*, *Syll.* viii. (1889) no. 424.
On sandy soil, *Rodway*, 139.

Lachnea stercorea, *Gillet*, *Disc. France* (1879), p. 76.
On cow dung, *Rodway*, 552.
The Tasmanian fungus is a trifle smaller in every part than the typical European form. The stellate hairs are well developed on the exterior of the ascophore.

Umbrophila aurantiaca, *Massee* (*sp. nov.*) *Ascomata* e subgloboso explanata, marginibus revoluto-convexis, substipitata, usque 1 cm. lata, subochracea, glabra, disco læte ochracea vel aurantiaca. *Asci* cylindracei, basi elongato-attenuati, apice iodo intense cæruleo-tincti. *Sporæ* monostichæ, hyalinæ, ellipsoideæ, plerumque biguttulatæ, 10–12 × 7–8 μ, continuæ. *Paraphyses* numerosæ, filiformes, apice vix incrassatæ, septatæ.
On trunk of *Dicksonia antarctica*, Labill., Hobart, *Rodway*, 619.
Distinguished from every known species of *Umbrophila* by the clear ochraceous colour of all parts.

Sphæropsideæ.

Ceuthospora innumera, *Massee* (*sp. nov.*). *Stroma* pustuliforme, nigrum, pluriloculare, loculis distinctis sine ordine dispositis, ostiolis prominulis, subcutaneo-erumpens, 0·5–1 mm. latum. *Sporulæ* hyalinæ, cylindraceæ, rectæ, 25 × 2·5–3 μ.
On a dead leaf of *Eucalyptus*, Rodway, 616.
Densely crowded, usually confined to one surface of the leaf; allied to *C. Oleæ*, Kalchbr. & Cooke.

New Zealand.

Sphæropsideæ.

Phoma Podocarpi, *Massee* (*sp. nov.*) *Perithecia* gregaria, atra, subepidermica, ostiolo suberumpentia, obtusa, contextu parenchymatica, cellulis minutissimis, 250 μ lata. *Basidia* filiformia. *Sporæ* hyalinæ, cylindrico-ellipticæ, utrinque obtusatæ, 2-guttulatæ, 9–10 × 2 μ.
On leaves of *Podocarpus ferruginea*, G. Benn., Otago, *Hector*, 80.
Allied to *P. Saxifragarum*, West.

Solomon Islands.

Ascomycetes.

Aposphæria Alpiniæ, *Massee* (*sp. nov.*). Perithecia gregaria vel sparsa, subcutaneo-erumpentia, globosa-depressa, atra, papillata, ·5 mm. lata. *Basidia* filiformia, 25–30 × 1·5 μ. *Sporæ* hyalinæ continuæ, ellipsoideæ vel obovatæ, episporio glabræ, 20–23 × 10–12 μ.

In a collection chiefly from New Georgia, on the branches of the inflorescence and also on the calyx and corolla of an *Alpinia*, *Officers of H.M.S.* '*Penguin*,' 1894-1895.

New Caledonia.

Sphæropsideæ.

Glœosporium Araucariæ, *Massee* (*sp. nov.*). *Acervuli* innato-erumpentes, convexuli, sparsi, pallidi, ·5–1 mm. lati, epidermide irregulariter lacerata cincti. *Basidia* filiformia, hyalina, 10–15 μ longa. *Conidia* elongato-subfusoidea, hyalina, 18–21 × 4–5 μ.

On the female cones of *Araucaria Rulei*, F. Muell., *Veitch*.

Allied to *G. Coniferum*, Sacc. & Roumeg.

Sierra Leone.

Ascomycetes.

Clypeolum sparsum, *Massee* (*sp. nov.*). *Perithecia* hinc inde in folii superficie sparsa, nec in maculis nigris insidentia, superficialia, epiphylla, glaberrima, atra, astoma, 250–300 μ diam. *Asci* cylindrici, sursum obtusissime rotundati, deorsum brevissime attenuato-stipitati, paraphysibus obvallati, octospori, 45–50 × 9–10 μ. *Sporæ* distichæ, oblongo-ellipticæ, medio 1-septatæ, non vel vix constrictæ, basi et apice obtusiusculæ, hyalinæ, 7–8 × 3·5 μ. *Paraphyses* filiformes, ascis longiores.

On living leaves of an unknown tree (*? Excœcaria*), in bush near Mofari, *Scott-Elliot*, 4431.

British East Africa.

Ustilagineæ.

Ustilago goniospora, *Massee* (*sp. nov.*). *Sori* nigro-violacei, ætate provecta brunneo-violacei, in ovariis evoluti. *Sporæ* irregulares, sphæroideo-angulatæ, 10–12 μ diam., episporio crassiusculo levissimo, mox secedentes et dein pulverem atro-violaceum efformantes.

In the ovaries of an undetermined *Aristida*, Ukamba, *Scott-Elliot*, 6491.

Sphæropsideæ.

Phoma Euphorbiæ, *Sacc. in Michelia* ii. (1882) p. 339.

On stem of *Tragia*, Mbuyuni, *Scott-Elliot*, 6200.

HYPHOMYCETES.

Cladosporium Herbarum, *Link*, *Obs. Mycol.* ii. (1791), p. 37.
On leaves of *Clugtia richardiana*, Muell. Arg., Ukamba, *Scott-Elliott*, 2334.

BRITISH CENTRAL AFRICA.

UREDINEÆ.

Uredo Euphorbiicola, *Sacc.*, *Syll.* vii. (1888) p. 847.
On *Euphorbia hochstetteriana*, ? Pax, Nyika plateau, North Nyasaland, *Whyte*.

SPHÆROPSIDEÆ.

Diplodia Tragiæ, *Massee* (*sp. nov.*). *Perithecia* subcutaneo-erumpentia, atra, glabra, papillata, globoso-depressa, circa 200 μ diam., sparsa vel subsolitaria. *Basidia* filiformia. *Sporulæ* elliptico-oblongæ, utrinque obtusatæ, 1–septatæ, episporio glabræ, violaceo-fuligineæ, 18–20 × 10 μ.
On stem of *Tragia* sp., between Kondowe to Karonga, North Nyasaland, 2000–6000 ft., *Whyte*.
Allied to *D. Humuli*, Fuckel, but readily distinguished from this and every other species by the dingy violet spores.

BERMUDA.

BASIDIOMYCETES.

Psathyra conopilea, *Sacc.*, *Syll.* v. (1887) no. 1060.
On the ground, St. George's, *Cummins*.

Hypholoma bermudiense, *Massee* (*sp. nov.*). *Pileus*, centro excepto, submembranaceus, e subgloboso expansus, glaber, levis, pallide ochraceus, versus marginem æruginascens, viscidus, 3–4 cm. diam. *Lamellæ* sat confertæ, postice rotundato-annexæ, e pallido fuscescentes, acie serrulatæ. *Sporæ* amygdaliformes, violaceo-fuscæ, 7 × 5 μ. *Stipes* æqualis, solidus, albidus, supra annulum angustum glaber, infra floccis squamosis evanidis tectus, 3–4 cm. longus.
On the ground, St. George's, *Cummins*.
Allied to *H. æruginosum*, Curt., but distinguished by the thin pileus and the coarsely serrated gills.

USTILAGINEÆ.

Ustilago Stenotaphri, *Massee* (*sp. nov.*). *Sori* ex olivaceo brunnei, atri, pulverulenti, ovaria habitantes. *Sporæ* irregulares, ovatæ, oblongæ, sphæroideo-angulatæ, 5–7 μ diam., episporio levissimo crassiusculo, olivaceo-brunneæ.
Parasitic on the ovaries of *Stenotaphrum glabrum*, Trin., St. George's, *Cummins*.

Uredineæ.

Puccinia Virg-aureæ, *Libert, Crypt. Arduenn.*, fasc. iv, no. 393.
On living leaf of *Solidago sempervirens*, Linn., St. George's, *Cummins*.

Costa Rica.

Ascomycetes.

Botryosphæria Anthuriicola, *Massee* (*sp. nov.*). *Stroma* erumpens, discoideum, atrum, 1–2 mm. latum. *Perithecia* subglobosa, ostiolo vix visibile. *Asci* cylindraceo-fusiformi. *Sporæ* monostichæ, hyalinæ, elongato-ellipticæ, utrinque acutæ, continuæ, glabræ, 17–20 × 4–5 μ. *Paraphyses* filiformes.
On dead leaves of *Anthurium gracile*, Lindbl.; Atino, Prov. Cartago, at 2100 ft., *Donnell Smith*, 6813.

Chile.

Peronosporeæ.

Cystopus Portulacæ, *Lév. in Ann. Sci. Nat.*, sér. 3, viii. (1847) p. 371.
On living leaves of *Calandrinia axilliflora*, Barn., Santiago *Philippi*.

DCLIX.—MANGABEIRA RUBBER.

(*Hancornia speciosa*, Gomez.)

Beyond brief notices (1892, pp. 67 and 69; 1898, pp. 179, 180) no account of this rubber has been given in the pages of the *Kew Bulletin*. The following short notes appeared in the *Kew Reports*:—

Hancornia speciosa.—Our attention having been drawn to this plant as the source of Mangabeira rubber, steps were taken to obtain, through correspondents, a supply of seeds. These we have received, and the plants raised from them will in due course be distributed. The plant itself is well known (*see* Collins, *Report on Caoutchouc*, pp. 23, 24). The rubber appears to be of good quality, and the tree has also the merit of producing an excellent fruit about the size of an Orleans plum, and yellow in colour, speckled with red. The fruit, in fact, in Pernambuco, is more valued than the caoutchouc.

I extract the following information from Consul Benham's *Report on the Trade of Pernambuco* (1879):—

"Mangabeira rubber is obtained from the trees of that name, which are to be found in large numbers in the interior of this, as well as of the other northern provinces. The reports which I

hear have been received from Liverpool of the reception of this article are far from favourable; the price went up to 2*s.* 7*d.* per lb., but has fallen again, and it would appear that 1*s.* per lb. is about the price obtainable in England in ordinary times. An idea of the great value of this article having got abroad here, the price rose to an absurd figure, having during this last season varied from 8,000 reis, or 16*s.*, to 26,000 reis, or 52*s.* per 15 kilos., or 33 lbs. The method employed in the preparation of the rubber is very primitive, and, I think, may easily account for the article not being well received; if the milk were treated in a more careful manner, there seems no reason why the rubber should not be favourably received. At present the plan adopted is simply to mix alum with the milk, which causes it to coagulate; the lumps of rubber are then placed in the sun, after which it is sent to the market; from this defective mode of preparation a great loss of weight afterwards occurs, frequently as much as 40 to 50 per cent., some say even more." (1880, pp. 47, 48.)

A quantity of good seeds of this plant (*Hancornia speciosa*) were sent to Kew by Mr. C. Craven, of Pernambuco, and were distributed among the following Botanic Gardens:—Brisbane, Calcutta, Ceylon, Demerara, Singapore, Java, and Jamaica. The seeds sown at Kew germinated freely, but owing to damp the plantlets all perished. Apparently this plant prefers a dry atmosphere and a sandy soil. (1882, p. 24.)

The following detailed account of the plant, and of the rubber obtained from it, is translated from a paper by Professor O. Warburg, in *Der Tropenflanzer*, *Zeitschrift für Tropische Landwirthschaft*, iii., p. 147:—

"Mangabeira rubber is the product of *Hancornia speciosa*, a tree of the Natural Order Apocynaceæ, found in those dry regions of Brazil which lie to the south of the forests of the Amazon. It occurs on the so-called Campos cerrados, in the Provinces of Pernambuco, Bahia, Goyaz, Minas Geraes, Matto Grosso and São Paulo. In the Provinces of Bahia and Pernambuco the rubber is chiefly obtained. The tree is abundant in the Provinces of Goyaz and Minas Geraes, and, according to Edwall,* in such amount as to be a characteristic plant of their Campos cerrados. In the coffee-growing Province of São Paulo, the range of *Hancornia* crosses its northern limit, the Rio Grande, and extends to the Paranaparema on the south, *i.e.* almost to the tropic of Capricorn, but seems to avoid the littoral zone and the coastal range known as the Serra do Mar: the chief places where it occurs are Serra Azul, Cravintras, São Simao, Araraquara, Casa Branca, Riberão Preto. While it is probable that as a wild plant it requires the well-marked dry period of its native campo, it can be grown in a more moist climate to a less luxuriant extent. Towards the west it spreads through Matto Grosso to the boundaries of Peru.

In Paraguay, at Jacuati, to the south-east of Concepcion, Balansa has collected a plant which, if not the same, is a very near ally.

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* Gustavo Edwall, "Die Mangabeira," in Deutsche Zeitung S. Paulo, No. 99, 1898.

In the Gran Chaco, and in Paraguay, an abundant tree, known on the Guarani as Manga-icé, and probably identical, yields an excellent caoutchouc which is collected in considerable quantity by a primitive method about Villa San Pedro.

Description.

The Mangabeira tree of the Brazilians attains the size of an apple tree, *i.e.*, a height of 16 to 23 feet, but in the Province of São Paulo fails at scarcely 12 feet. It branches freely, forming a crown, the breadth of which often considerably exceeds the whole height of the tree. Its many rather pendulous branches bear short lateral branchlets, and are leafy only at the extremities. The young twigs are brownish and smooth, the old branches encased in a corky bark. The opposite paired leaves are elliptic or long-elliptic in shape, are contracted towards the rounded apex, 2–4 in. long and $\frac{1}{2}$–$1\frac{1}{2}$ in. broad. The leaf-stalks are short—as a rule but $\frac{1}{5}$ in. long. In nervation the leaf is well marked ; it has a straight midrib from which on either side spring numerous veins parallel to one another, and sometimes forked to support the margin, close to which they end.

The flowers are shortly stalked, about $1\frac{3}{4}$ in. long, and grouped as many as seven together on the ends of the branches. The calyx is small, about $\frac{1}{10}$ in. long, glabrous or hairy, with five small, ovate, obtuse teeth. The corolla is $1\frac{1}{3}$–$1\frac{3}{4}$ in. long, with a long, narrow cylindric tube blocked by hairs at the middle, and with five small lanceolate somewhat reflexed lobes, half as long as the tube. The five stamens are inserted on and enclosed within the corolla-tube, and have lanceolate acute anthers. The style is filiform, long, and bears at its apex a two-lobed stigma. The ovary is two-celled, with many ovules in each cell, of which but one cell and a few ovules mature in the ripening fruit.

This fruit is of the size of a plum, fleshy, with an agreeable taste, and contains the few matured seeds embedded in the flesh. When ripe it is yellow, with blotches and streaks of red. It keeps but a short time, yet is much prized as a food, being eaten fresh and cooked in many ways. While the Portuguese call it Mangába, the natives use the name Tembiú-catú, which means "good to eat." A drink as well as a conserve is made from it.

Climatic Requirements.

According to information from Mr. S. Woldern, British Vice-Consul in Ceará, the tree grows wild in all wooded districts, on sandy soil. For its culture sandy soil in the plains, especially toward the coast, is most suited. The statement that the tree grows from 3,000 or even 4,000 to 5,000 feet above the sea is, according to Marval Irmaos, of Bahia, incorrect, the plateaux on which it occurs being but of 500 to 600 feet elevation.

Cultivation.

But little positive information is to hand under this head. In most of the great gardens of Asia and the West Indies the tree seems not to be grown, although in 1880 steps were taken by

the Botanic Gardens of Kew to cultivate it. Seeds were received and seedlings raised at Kew, but of the result we have no information.

At any rate, the tree needs no shade. Experiments are needed as to the best method of propagating it, which in the Province of São Paulo is done both by cuttings and from seed.

Yield.

Equally is little certain at present about the yield. When four or five years old, or, according to other trustworthy authorities, when six years old, the tree is mature enough to be tapped. This is done by cutting a spiral groove or, as is preferable, oblique incisions in the bark at some distance from one another, eight of such, perhaps, in the whole length of the trunk. Below the incisions, by the use of a little moist clay, a trough is made to catch the juice as it runs out. At the end of a quarter to half an hour the supply is exhausted. This may be 2 lbs. and upwards, though in the rich parts of São Paulo—the terra-roxa (red earth) district, celebrated for its coffee—as much as 11 lbs. of juice may be obtained. A colouring matter in the bark gives to the fresh juice a delicate rose tint.

The latex from the little clay collecting troughs is then poured into larger vessels, and mixed with alum (Stauss' method). This produces coagulation in two or three minutes. Two teaspoonsful of alum solution are sufficient for milk enough to fill two or three bottles. The caoutchouc is then pressed by hand, and hung on sticks in the sun for eight days to allow the water to exude and drain off. The product thus prepared is in the form of large cakes called biscuits ; it still contains much water, and belongs to the class of caoutchoucs known as moist rubbers.

It is obvious that the making of the rubber into thin "sheets," instead of biscuits, is of advantage, for it gives facilities for drying, and consequently adds to its value. This mode of procedure has recently begun to take a place in the preparation. Other changes are suggested by Biffen's method of obtaining pure caoutchouc by the use of a centrifugal machine. Cannot some method of collecting and preparing Mangabeira rubber be found which will yield more nearly such a product as the trade desires ?

Trade.

"Pernambuco biscuits" are large rectangular cakes of a reddish-brown colour outside, but bright rose-coloured inside, with a peculiar sweet scent, full of cavities containing a solution of alum, and usually with marks of its exudation on the surface. In the working up of the rubber, a loss, sometimes of as much as 40 to 60 per cent., occurs. The caoutchouc is but little elastic, hardens with age, breaks and tears—faults attributed to the presence of the alum. The demand for such rubber is small, and due chiefly to its pleasing colour ; and the price in consequence is but half that of Para rubber.

Recently, however, the price of Mangabeira rubber has advanced by reason of the improvement in the purity, and on account of its great suitability, when pure, for certain purposes.

In consequence, the disparity between the price of the best sorts and that of Para rubber is much diminished. At the end of last year, a kilogramme (2 lbs. 3 ozs.) of the best Mangabeira rubber sold for upwards of 12 milreis (almost 8 shillings), a price not far short of that of Para rubber. An additional cause of the advance in price is to be sought in the change in making up the rubber; for, owing to the constant watch which is necessary to guard against adulteration by addition of iron or stones put in to make weight, pieces of rubber only $\frac{1}{2}$–$\frac{3}{4}$ in. thick and 2 ft. long by 10 ins. broad, the so-called "sheets" of commerce, are welcome in the trade.

Of recent years, the exploitation of this source of rubber has taken a considerable extension. And, while the intelligent collectors, who start from Bahia and work toward the interior, have only tapped mature trees, improvident itinerant collectors, making their own profit out of the pressing demand of the time, have in many places mischievously drawn on the supply and threatened its continuance.

The chief centres for export of Mangabeira rubber are Bahia and Pernambuco. A large supply is brought down the river São Francisco, and so to Bahia; and from this town, in 1889, 134 tons were exported; in 1892, 4,362 bales, to the value of £22,826; and in 1893, 3,293 bales, to the value of £20,362. From Pernambuco were exported, in 1896, 54 tons, to the value of £1,800.* A small amount of caoutchouc from the Province of Matto Grosso (probably Mangabeira rubber) is exported down the Parana through Paraguay, and great quantities from Minas Geraes are shipped through Rio de Janeiro.

Recently, the Province of São Paulo has begun to demand a place in the consideration of rubber export. Regions here, such as that through which the Mogyana railway runs, are exploited, even by persons coming from Bahia for the purpose, the owners of the land receiving, in return for the permission they grant, one-third of the clear profits. A worker can collect about $6\frac{1}{2}$ lbs. of rubber per diem, and receives on the spot 75 milreis (£2 9*s.* approximately) per arroba ($32\frac{1}{3}$ lbs.). The arroba is sold in London for 200 milreis. In the first half of the year 1898, no less than 76,498 kilogrammes (approximately 78 tons) of rubber were passed over this railway, and yet the railways of Paulista and Sorocaba equally traverse the country where the Mangabeira tree grows. In consequence of the increasing trade, Santos has become an important centre for rubber, and there, as at the town of São Paulo, now exist mercantile houses whose principal concern lies in this business.

In this Province, an idea of the importance of cultivating and protecting the tree is arising. Many coffee-planters are turning their attention to the sowing of *Hancornia*, and seed is already hard to procure. The Government hoping, by means of the duty on rubber (now standing at 13 pèr cent. ad valorem), to recuperate its finances, which have become disordered by the depreciation of coffee, has instructed Dr. A. Uchoa Cavalcanti, Acting Director of the Agricultural Institute at Campinas, to inspect the territory

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* Probably an error for £18,000.

in question; and further, the Congress of the State has decreed that the Mangabeira tree shall be protected, and its cultivation extended, as is advisable.

This decree, in brief, runs as follows :—

Article 1. §i. A premium of 25 contos of reis (25,000 milreis, or about £784) shall be paid to him who, within four years' from the passing of this decree, shall show that within a distance of 60 kilometres (37 miles) of a railway, he has planted and cultivated, for 2 years at least, the greatest number of Mangabeira trees, preserving between the trees enough room for their free development.

§ii. A premium of 15 contos (nearly £470) to him who shall have planted the second greatest number.

§iii. A premium of 15 contos to him who shall have fulfilled all the conditions of the first paragraph, excepting the requirement with regard to the distance from a railway.

§iv. A premium of 25 contos to him who, within the same space of time, and within the prescribed 60 kilometres of a railway, shall have cultivated, for two years' at least, the greatest number of Mangabeira trees, provided that at the same time he shall have enclosed the ground, and removed all other trees.

§v. A premium of 15 contos to whoever shall have cultivated, etc., the second greatest amount.

§vi. A premium of 15 contos to whoever shall have fulfilled all the conditions of the fourth paragraph, except the requirement with regard to the distance from a railway.

§vii. A premium of 10 contos (about £313) to whoever shall prove that within the same lapse of time he shall have acclimatised in a manner profitable from the agricultural standpoint any other species of rubber tree, *e.g.*, *Manihot Glaziovii*.

Article 2. A premium of 15 contos of reis to whoever shall show that within the same time he has devised the best method of extracting the latex.

Although but little is known so far of the cultivation of Mangabeira, it may be said that there is a considerable probability of it becoming an important tree in rubber-culture. The apparently easy accommodation of the tree to soil and climate, its early and considerable yield, together with the fact that even under the rough treatment of the Indians it preserves its fruitfulness, and also the facility with which it can be cultivated, promise a future. And, taking a wide view of its possibilities, from its presence in the red coffee-growing soils of the west of the Province of São Paulo, it appears suitable for the red-earths of the German Colonies of Africa, Usambara and Togoland alike, such, for instance, as occur at Misahöhe, in the latter colony. For these soils it promises to be considerably better suited than the Ceara rubber plant (*Manihot Glaziovii*), and the Para rubbers (*Hevea*), and will probably give better results than *Castilloa*, than which it is more hardy, earlier maturing, and smaller."

DCLX.—MISCELLANEOUS NOTES.

Mr. William Hales, a sub-foreman in the Royal Botanic Gardens, has been appointed on the recommendation of Kew, Curator, to the reorganized Chelsea Physic Garden.

Mr. Albert Howard, B.A., Scholar of St. John's College, Cambridge, has been appointed by the Secretary of State for the Colonies, on the recommendation of Kew, Lecturer in Agricultural Science in Barbados.

The news of the sudden death at the early age of 56, of Henri Lévêque de Vilmorin, on August 24th, at his country seat, Verrières, near Paris, was received at Kew with the profoundest regret. De Vilmorin had worthily continued the traditions of the great house of Vilmorin Andrieux et Cie., in which he succeeded several generations of his family. Its business of seedsmen is no doubt the most widely extended and possibly the largest in the world. Its affairs constantly brought him to England, and he rarely failed on such occasions to visit Kew, to which he never ceased to extend the warmest friendship. He could not in fact have shown more interest in or regard for its work had it been an institution of his own country.

But it was not as a mere man of business that De Vilmorin will be remembered. He brought a keen scientific intelligence to bear upon the variation of plants under cultivation, and his numerous writings will always remain classical authorities on the subject. These pages owe to them the interesting account (*K. B.* 1879, pp. 317–8) of the process, in which he had so large a share, by which the sugar beet has been brought to its present condition as a commercial source of sugar.

The name of few men was better known throughout Europe; it might be even said throughout the civilised world. A man of dignified presence, with singular charm of manner, and an alert and sympathetic mind stored with the most varied but precise information, he at once attracted attention in any society. Kew had frequently to invoke his aid when the needs of our colonies required the resources of a warmer climate than that of the British Isles; and when one asked De Vilmorin to do a thing, one could rely upon its being as effectively accomplished as if one had done it oneself. A loveable nature, a fine enthusiasm, and a sterling integrity inspired a noble character.

Botanical Magazine for August.—A quarto plate is given to *Aloe Schweinfurthii*, a magnificent species discovered by Dr. G. Schweinfurth in North-east Tropical Africa. It flowered in the garden of Thomas Hanbury, Esq., of La Mortola, in February. *Heliophila scandens* is one of the remarkably few Cruciferæ with a scandent habit. The Kew plant, which was received from

J. Medley Wood, Esq., A.L.S., Curator of the Natal Botanic Garden, in 1885, flowers annually in the Succulent House during the winter. The flowers are white, or sometimes slightly pink, and fragrant. *Aster Piccolii*, a new species, was raised from seed collected in North China by Father Piccoli, of the Jesuit Mission, and received at Kew through G. Murray, Esq., F.R.S., of the Natural History Museum, South Kensington. It is a useful species for the flower garden, and interesting botanically on account of the absence of pappus. *Ephedra altissima* was drawn from material also sent by Thomas Hanbury, Esq. Its abundant bright-red fruits render it a striking object in the gardens at La Mortola. It is a native of North Africa, and is not hardy in Great Britain. *Mussænda capsulifera* is a pretty white-flowered species from Socotra, whence seeds were brought by the late Mr. G. Theodore Bent, in 1897.

Botanical Magazine for September.—*Coleus thyrsoideus* is a free-growing species from British Central Africa, whence Herbarium specimens bearing fertile seeds were sent to Kew by A. Whyte, Esq., F.L.S. The flowers are rather large, bright blue, and are borne in long terminal panicles. *Begonia sinensis* is a tuberous-rooted species with small pale rose-coloured flowers. Seeds from which the Kew plants were raised were received from Dr. A. Henry, M.A., F.L.S., who collected them in Yunnan. *Calathea picta* is one of Mr. Bull's recent introductions from Brazil, and has been distributed under the name *Maranta picta*. Its leaves are dark velvety green above, marked with blotches of pale green, and purple below. *Asparagus scandens* is the first representative of the genus figured in the *Magazine*. This species was introduced into England from the Cape by Mr. Francis Masson at the end of the last century. The specimen drawn was sent to Kew by Mr. Leech, of the gardens at Woodhall, Dulwich. *Dorstenia Phillipsiæ* is a curious species from Somaliland, where it was discovered by Mrs. Lort Phillips and Miss Edith Cole, who sent the plant from which the drawing was made to the Botanic Garden, Cambridge. In habit it closely resembles *D. arabica*, Hemsl., of which a figure appeared in *Hooker's Icones Plantarum*, t. 2503.

Flora Capensis.—Part 3 of vol. vii., edited by the Director, was published in September. It contains a further instalment of the elaboration of the *Gramineæ* by Dr. O. Stapf.

Flora of Tropical Africa.—Part 1 of vol. v., edited by the Director, was published in September. It contains the first instalment of the examination of the *Acanthaceæ*, a family largely represented in the tropics of both worlds, and but scantily in temperate regions. This has been undertaken by Messrs. I. H. Burkill, F.L.S., and C. B. Clarke, F.R.S. The latter gentleman brought to bear upon the work a unique knowledge of the Indian

representatives of the family. The discrimination of genera and species in it is both intricate and difficult, and Mr. C. B. Clarke was unable to complete his work without a visit of some duration to Berlin to study the African species described by German botanists.

Botanic Station, St. Lucia.—It has been constantly insisted upon in the *Kew Bulletin* that the only chance for some improvement in the present distressed condition of the West Indies is to multiply as much as possible the cultural industries. Administrator King Harman's Report on St. Lucia for 1897 (pp. 18–20) affords an interesting example of what has already been done in this direction in that Island.

Botanic Station.

"Much activity has prevailed in connection with the Botanic Station, in which an increasing interest is shown by the general public. Plants were distributed throughout the Island to the number of 21,138, exclusive of 9,000 ginger sets given gratis to purchasers of Crown lands, and an impetus has been given to the cultivation of Liberian coffee, cocoa, nutmegs and kola, the number of each disseminated by sale, exchange or free gift being as follows :—

——	Sale and Exchange.	Free.	Total
Liberian coffee	10,942	5,994	16,936
Cocoa	44	1,302	1,346
Nutmegs	444	463	907
Kola	214	704	918

The following table, shewing the number of economic plants distributed during the last three years, affords satisfactory evidence that the station is increasing in favour with the public, and that its sphere of usefulness is being constantly enlarged :—

Year.	No. of Plants Distributed.
1895	4,380
1896	19,504
1897	22,179

In addition to the assistance given to the planting community at the station itself, the Curator is paying periodical visits to the several districts of the Island for the purpose of giving lectures and practical demonstration upon agricultural topics, in the hope of encouraging an extended cultivation of the most useful and valuable economic plants upon rational and scientific principles.

The site of the present station leaves unfortunately much to be desired, and with a larger area and more suitable land the advantages now offered will be brought home with greater force to the general public.

Cocoa.

The crop for 1897 was a small one, owing to the heavy rainfall and wind experienced during the flowering period of May and June. The cultivation is slowly increasing, and it is hoped that the excellent results obtained by the few planters who apply intelligent methods to the treatment of their crop may, together with the sound advice tendered by the Curator of the Botanic Station when on his lecturing tours, induce the petty proprietors to improve on the primitive system to which they obstinately cling.

Coffee.

Liberian coffee is proving to be well adapted to the soil and climate of St. Lucia, and its culture is being extended. The demand for seeds and plants is increasing, and improved machinery for curing the crop is being imported.

Kola.

The cultivation of kola is being slowly extended and one shipment has been made to the London market, where good prices were obtained.

Ginger.

The cultivation of this spice is at present being tried by one or two planters only, but a shipment which was made in the month of June realised 70/- per hundred weight, and the profitable nature of the undertaking is being brought to the knowledge of the people.

The estimated acreage of the products cultivated in the Colony is given in the following return :—

	Sugar Cane.	Cocoa.	Coffee.	Spices.	Provisions.	Other Cultivation.	Pasture.	Total Cultivation.
Acres	5,234	3,940	104	11	3,944	323	12,234	25,790

The estimated acreage of the Colony is 152,320."

Chelsea Physic Garden. — The following account of the reorganisation of this old Botanic Garden is extracted from the *Times* of April 18, 1899 :—

"The garden was established by the Society of Apothecaries in 1673. In the first instance, the ground was apparently leased by them from Lord Cheyne as a site in which to keep the ornamental barge that was a usual appanage of a City Company at that period, but at least a portion of it was almost immediately devoted to the culture of herbs for the use of the Society's laboratory. From the beginning the Apothecaries evidently felt its expenses a serious burden on their resources. Some 40 years after it was established, they approached Sir Hans Sloane, who had purchased the manor of Chelsea from Lord Cheyne in 1712, with the desire of obtaining his assistance, and the outcome was that in 1722 he granted them the land for ever in consideration of a yearly rent of £5 to the end that "The said gardens may at all times hereafter "be continued as a Physic Garden, and for the better encouraging "and enabling the said Society to support the charge thereof, for "the manifestation of the power, wisdom and glory of God in "the works of the Creation, and that their apprentices and others "may better distinguish good and useful plants from those that "bear resemblance to them and yet are hurtful, and other the "like good purposes."

The grant further provided that, if the conditions were not fulfilled, or if the Society should at any time convert the garden into buildings for habitation, or to any other uses save such as were necessary for a Physic Garden, it should be lawful for Sir Hans Sloane, his heirs and assigns to enter upon the premises and hold them for the use and benefit of and in trust for the Royal Society, or if that body refused to accept the duties entailed, then in trust for the College of Physicians of London, subject to the same conditions as those originally charged on the Apothecaries.

In spite of these very clearly-expressed intentions on the part of Sir Hans Sloane, who may in a sense be regarded as the "pious founder" of the garden, on several occasions the alienation of the place to other purposes has been distinctly contemplated. In 1893 the Apothecaries formally applied to the Charity Commissioners with the intention of getting their trusteeship discontinued. In the absence of any endowment specifically applicable to the garden (with the exception of two bequests of £200 and £100 respectively) the cost of maintenance fell heavily on their corporate revenues. Moreover, it was urged on their behalf that, as a botanic garden, the place possessed neither merit nor attraction, and that it was impossible to galvanize it into a state of active and beneficial usefulness. They had carried it on of recent years, they said, only in the hope that it might be utilized for other purposes, and because of its potential value, the latter being the reason why rather than relinquish it they would prefer to allow it to become a wilderness. In this connection, it may be mentioned that the value of the site, which extends to about $3\frac{1}{4}$ acres, is estimated at fully £50,000 as a freehold property.

After the Society's application proceedings were delayed for a few years pending the report of the Gresham University Commission, but in 1897 the whole question was thoroughly thrashed out by a Treasury committee, consisting of Sir Henry Longley, Sir W. T. Thiselton-Dyer, and Mr. Spring-Rice. The first points they investigated were the suitability of the garden for the purposes of its original foundation, and the extent to which those purposes are within the range of the scientific requirements of the present day. They came to the conclusion that the place is still fitted for botanical uses. With an airy and open position, it is well set up to the south, and, if the ground shows signs of exhaustion, that is due to its having been starved in the past, and could be remedied by liberal application of manure. The natural soil, they were informed, is distinctly superior for botanical purposes to that of Kew Gardens, which, by the way, it is interesting to note, are in a sense an offshoot of the Physic Garden, having been first organised in 1759 by William Aiton, a pupil of the Philip Miller who was appointed gardener at Chelsea in 1722. Nor, again, had they any doubt but that the garden is capable of being usefully employed for the promotion of botanical science at the present time, since the evidence they received from several educational institutions showed that there exists a considerable body of students of botany, to whom such a garden would be of immense advantage, both as a place where growing plants can be observed and as a source whence specimens may be obtained. Having decided as to the practical usefulness of the garden, the committee proceeded to discuss ways and means of maintaining it efficiently. In considering this question they held firmly to the principle that, as the original trusts were strictly educational in character, in any scheme of reconstruction it must be devoted to serious scientific and educational purposes, and not given up to the perambulators of the nursemaid or the fantasies of the ornamental gardener. Moreover, they felt that any course of administration tending to give it the character of a public park or recreation ground for local residents would weaken its claim to support from general taxation. Ultimately they decided that it was not desirable to hand it over to any existing body. If it were entrusted to the County Council, which, they noted, has no power to make any permanent appropriation of funds for such an object, they foresaw that the fact of its being maintained out of local rates might possibly lead to its diversion from strictly educational purposes to those of a recreation ground, while, if its administration were undertaken by a Government Department, Parliamentary pressure might be brought to bear for the same end. The solution of the problem they found in a new body specially constituted for the administration of the garden and representative not merely of the educational interests involved, but also of bodies able and prepared to furnish funds; for they thought that such a body would not only be free from popular influences likely to impair the educational value of the garden, but would also represent both the Imperial and local elements of the original trust.

The arrangement proposed on these lines by the committee was considerably modified because the trustees of the London parochial charities found themselves able to take a much larger share in the administration of the garden than was at first expected. In the

scheme sanctioned by the Charity Commission the trustees of the London parochial charities are the sole trustees of the garden, while the management is vested in a committee consisting of 17 members. Of these, one is *ex officio*, and is either the person entitled as the representative of Sir Hans Sloane to receive the yearly rent of £5 under the indenture of 1722, or some one nominated by him. The others are appointed, nine by the trustees of the London parochial charities, and one each by the Treasury, the Lord President of the Council, the Technical Education Board of the County Council, the Royal Society, the Pharmaceutical Society, the University of London, and the Society of Apothecaries and the Royal College of Physicians in turn. The charity and its endowments are to be administered exclusively for the promotion of the study of botany, with special reference to the requirements of general education, scientific instruction and research in botany (including vegetable physiology) and instruction in technical pharmacology as far as the culture of medicinal plants is concerned. Existing buildings are to be adapted or new ones constructed for the purposes of offices and rooms for lectures and experimental teaching with the aid of botanical specimens, while a physiological laboratory with appliances for demonstration and research may also be provided. In support of the institution the trustees are to contribute out of the income of the City Parochial Foundation an annual sum not exceeding £800, together with such an amount of capital for the equipment of the garden and buildings as may be agreed upon with the Charity Commissioners. In return the students of institutions receiving aid from the London parochial charities are eligible for admission without fee. So long, too, as not less than £150 is paid annually to the trustees out of moneys specially provided by Parliament, the same privilege is accorded to the Royal College of Science, and its students, professors and teachers are to be entitled to use for purposes of teaching or research the garden, botanical collections, and lecture rooms for not less than three hours on each day between April 1 and October 31, and on two days of the week during the rest of the year. In other cases the rules for admission and the fees (if any) to be charged are within the discretion of the committee of management, subject to the approval of the Charity Commissioners."

Uganda Juniper.—The following note deserves recording, if only to commemorate the late Capt. B. L. Sclater, R.E., who sacrificed a life of promise in opening up the access to Uganda from the coast, and added one more name to the band of distinguished men who have perished in the work of African pioneering.

The promised specimens were never destined to reach Kew. But there is little doubt that the Juniper referred to is *Juniperus procera*, Hochst. Roth says of it on the label of an Abyssinian specimen in the Kew Herbarium :—"Arbor altissima, sylvas constituens, unica e familia Coniferarum. Lignum usitatissimum." The other Conifer is most probably a *Podocarpus*.

EXTRACT from Captain B. L. Sclater's letter, dated Eldoma, Mau Escarpment, British East Africa, April 9th, 1896, to Mr. P. L. Sclater, F.R.S.

"I think I told you about the Juniper forests on the top of the Kedony Escarpment. The forests to the north of Lake Naivasha are of the same Juniper, and we are building the bridge over the Morendal with it. It is also extremely plentiful here, and I have seen large trees 200 feet high, and at least 8 feet in diameter at the base. There is also another kind of conifer here, more like a pine, which grows to a good size. There are plenty of young junipers here, but I have not yet been able to find cones of either sort. Please let me know if they are known at Kew, as I can easily send home specimens of the wood and leaves. I will get the cones if I can."

Mr. Alexander Whyte, F.L.S., Curator of the Botanic Station, Uganda, writes, January 20th, 1899 :—

"The juniper is a most excellent timber, and will prove a source of revenue now that the railway is nearly up to the Nirobi forests. Sclater's bridges are made of it, and they are as good as the day they were erected."

Soudan Products.—Comparatively little is known at present as to the available resources of the Soudan. The following preliminary account appears in the *Board of Trade Journal* for July of the present year (pp. 30, 31) :—

The Foreign Office have received, through H.M. Agent and Consul-General at Cairo, a report by Sir William Garstin, K.C.M.G., on the Egyptian Soudan, of which the following is an extract :—

"A very possible source of future wealth to the Soudan lies in the vast forests which line the banks of the Upper Blue Nile and extend, in an easterly direction, to the Abyssinian frontier. In the Bahr-el-Ghazal Province also, particularly in the Bongo country, large forest tracts exist.

The ebony tree (*Dalbergia melanoxylon*) is met with south of Karkauj, on the Blue Nile, and again in the vicinity of the Sobat River. This tree does not, in these latitudes, attain to a very large girth, 9 inches being apparently its maximum diameter. It must, however, be very common in these forests, as most of the principal houses in Omdurman are roofed with it. The value of *Acacia arabica*, from which the white and red gum is obtained, is well known ; while the other kinds of acacia, such as *Acacia nilotica* (in Arabic, "Sant"), are the chief source of the fuel supply.

A bamboo is met with in the ranges of hills to the south of Famaka, and, according to some, "mahogany" is found in the forests round Fazogl and in the Beni Shangul country.

The means of transporting such woods can only be by the river. Unfortunately, neither the ebony nor the acacia will float in water, and, therefore, such transport is debarred in these cases. If a good and serviceable timber tree can be

discovered in the Blue Nile forests which can be floated down the river to Egypt, a large source of revenue will undoubtedly have been found. Extensive saw-mills might be erected at Assouan, utilising the power available at the dam, now under construction, and an important timber trade might one day arise.

On the White Nile, in the Bongo and Rohl districts, the india-rubber creeper (*Landolphia florida*) is found in great profusion. If the rubber yielded by this creeper be not of quite so good a quality as that obtained from the Assam india-rubber tree (*Ficus elastica*), it is still of sufficient value to be counted as an important asset in the future trade of the Soudan. This plant, which has large laurel-shaped leaves, and a white flower resembling a jasmine, requires several years to mature before yielding rubber in any quantity. The natives obtain what they require by tapping the stem, usually in such a reckless manner that the creeper dies under the operation. The Assam india-rubber tree should certainly flourish well in most parts of the Soudan, more particularly south of Khartoum. Although this tree takes from twenty to thirty years to arrive at a girth sufficient to permit of regular tapping, its yield is so valuable (about 3*l*. per tree per annum) that its introduction into the country is well worth attempting.

It is very much to be hoped that a scientific examination of the Soudan forests may ere long be carried out under the superintendence of an expert. An Indian forest officer (from Burma for choice) might be deputed for this purpose. It is certain that much valuable information would be obtained from his report. Such an appointment needs no recommendation—its necessity is obvious. A trained forest officer could, moreover, render good service by advising the Government as to the best method of preserving the valuable fuel supply which at present exists on the banks of both rivers. This supply, although apparently inexhaustible, must speedily diminish, unless the cutting and felling of the areas is carried out upon some regular system which will permit of the young trees growing up and replacing those cut down. It is, of course, inevitable at present that the felling should be carried out in a wasteful manner. Fatigue parties are landed from the boats, and are required to cut the largest amount of wood in the shortest possible time. The men have no idea of the value of the trees, and naturally select those which are nearest to the water and easiest cut. Should this practice be continued, it is certain that a few years must see a great diminution in the belt adjacent to the river. On the Blue Nile even the valuable gum-producing acacias are being felled for fuel."

Cochin China Gutta-Percha.—Enquiries having been made as to this product and the plant producing it, the following note is reproduced from the Kew Report for 1881 (pp. 45, 46) :—

M. L. Pierre, [late] Director of the Botanic Garden, Saigon, gives in the *Excursions et Reconnaisances*, no. ii., published by the French Colonial Government at Saigon, an interesting account of the gutta-percha derived from *Dichopsis krantziana* (Pierre *in*

Beauvis, *Contr. Gutta-Percha* 60, t. 1), which appears to be a source of one of the inferior qualities met with in commerce. As the publication appears difficult of access in Europe, I quote his remarks :—

" This tree furnishes a large quantity of a milky juice, which yields a gutta of inferior quality, judging from experiments made by experts in Paris. It must be remarked, however, that the sample experimented on was obtained by the defective method used by the Cambodians in the manufacture of torches and had become resinous. The Cambodians sell it to the Chinese, who export it to Singapore, where it is sold as an inferior kind of gutta. The product, in fact, altogether varies in its texture according to its mode of preparation. The milky juice left to itself and coagulated yields a whitish substance which is not resinous nor glutinous. The absence of the last character is an essential property of good gutta. When on the contrary the milk is coagulated with hot water, it has a glutinous texture highly injurious to its commercial value. In this state it is useless, except to mix with gutta of better quality. To prepare it properly it should be poured into earthern vessels and allowed to slowly evaporate without the application of any artificial heat. The process is slow, but it is that which is employed in Malaya in the preparation of the best sorts of gutta." (p. 227.)

M. Pierre very obligingly communicated a specimen of his Cochin China plant to the Kew Herbarium. Mr. C. B. Clarke remarks upon it :—" Seems very near a species I have made, " *Dichopsis Helferi*, on a Tenasserim tree, of which the fruit is " not known. The leaves do not quite match either in shape or " in number of nerves, nor are the sepals exactly the same. They " may be one tree nevertheless."

Rattan Industry of Rheims.—The following account is extracted from the *United States Consular Reports* for January, 1898. The use of canes and rattans is to some extent displacing that of willows for basket work. The suggestion has been made that the species of Calamus which yield rattans and canes might be introduced into the forests of Tropical Africa, where a few species of the genus already occur.

" Rattan is the name given to more than one hundred species of climbing palms of the genus *Calamus*, natives of inter-tropical Asia and Africa, most or all of which are perennial, simple or unbranched, cylindrical, jointed, very tough and strong, from the size of a goose quill to the size of the human wrist, and from 50 to 100 feet in length.

In the regions where it grows wild, rattan renders forests inaccessible by reason of its long, tough, and thorny stems, running from tree to tree and on the ground. These stems are used in the manufacture of numerous articles, the principal among which are walking sticks (very much in demand and often very high priced), riding sticks, cables, and very strong ropes, and when split into thin strips, are used for making seats of chairs, baskets, withes and thongs, and all sorts of wicker ware.

One species of rattan—the *Calamus Draco*—from which is extracted a red, resinous substance, is employed for medicinal purposes.

From India is taken the rattan used in making walking sticks; its stem is very long, a little over 0·39 inch in thickness, with joints 19·68 to 39·37 inches apart.

From Cochin China and the Sunda Islands are annually exported large quantities of *Calamus rudentum*, one of the largest kinds of rattan, used for cables and ropes. Its stem is very long and 0·78 inch thick near the middle, and from 1·37 to 1·96 inches in the lower part, its joints being often 78·74 inches distant from each other. These natural cables are so resistant and strong that, it is said, they are used for capturing wild elephants. Strong and handsome walking sticks are made from this species, and also from the *Calamus Draco*, the joints of the latter being from 59 to 62 inches apart.

From the Sunda and Philippine Islands are taken: (1) the *Calamus equestris*, used in the manufacture of riding sticks, a species from 196 to 221 feet in length and no more than 0·39 inch in thickness, with its joints 7·87 inches apart; (2) the *Calamus viminalis*, a species slimmer than the latter, which is used for wicker ware.

The manufacturers of rattan in the consular district of Rheims buy their raw material in Germany and Holland, whither it is shipped from Dutch India after a first preparation.

First of all, the bark is taken off and is used for making seats of chairs. The core of the stem is then split into several thin pieces and rounded off, when it is ready for making baskets.

To whatever use the rattan is put, it must be first decorticated and scraped. If it is desired to bend or plait it, it is softened in hot water, to which is added muriatic acid. Thick rattan is bent with light saw cuts, as is done with ordinary mouldings.

The output of the factories of this region is mostly consumed in the neighbouring territory and sold to wicker workers residing therein; the balance is purchased by Paris and a few London firms.

There are only two important and well-known rattan factories in this consular district which do a very good business.

Raw rattan, taken on board vessels in French ports, sells as follows: First quality, $15.44, and second quality, $13.51, per 100 kilograms (220.46 pounds.)

HENRY P. DU BELLET,
Consul.

Rheims, November 27, 1897.

Sugar-cane in Sandwich Islands.—In the competition between the sugar-cane and the bounty-fed beet root it can hardly be doubted that with the increased amount of solar energy available in the tropics, the sugar-cane ought to hold its own, if the same scientific resources were brought to bear on its improvement and cultivation. In other words, the sugar-cane industry will have to be reorganised. What has been done in this direction in Queensland is touched upon in the *Kew Bulletin* for 1897, p. 96. The

following extract from Mr. Acting Consul-General Kenny's *Report on the Trade of the Hawaiian Islands* for the year 1897 (*Foreign Office, Annual Series*, 2193, pp. 7, 8), gives an interesting account of the state of their sugar industry :—

"The sugar industry of the Islands prospered during the year 1897, all the plantations paying large dividends.

Although the financial success of the sugar business is largely due to the treaty of reciprocity with the United States, there can be no doubt that a considerable measure of it is also due to the intelligent systems which have been adopted by the planting community, and to the introduction of improved methods of agriculture and manufacture.

A few years ago the sugar planters of the Islands formed themselves into an association, and established a laboratory and experimental station, from which much benefit has been derived. The director of this association makes periodical visits to the plantations, and prescribes such fertilisers as may be required, after a careful analysis of the soils has been made by the chemists of the association. The analyses of all fertilisers used by the planters has to be guaranteed by the manufacturers, who are not paid until their goods pass the tests made for the buyers. In this way fraud and careless manufacture are checked, and the planters are protected.

At the experimental station of the association, sugar-cane of different varieties is grown and tested, and various experiments of value are continually being made in fertilisers, irrigation, and other matters connected with the successful raising of sugar-cane.

The favourable weather of 1896, and the unusually large area of cane harvested, brought the 1896–97 crop to the highest point yet reached, which, according to the planters' association returns, was 251,126 tons, of 2,000 lbs.

The 1897–98 crop will, probably, be under this, owing to the exceedingly dry weather last year, which seriously interfered with the growth of cane in the unirrigated districts.

After much experimenting it has been finally decided that the most effective machine for the extraction of the juice from the cane is the "nine-roll-mill," which is made up of three three-roll-mills, so that the cane is pressed six times, and on its passage from one mill to the next it is subjected to "maceration," by means of a stream of hot water, which assists in forcing the cane to yield its juice. The rollers of these mills vary in size, but the usual measurement is 30 inches in diameter and 60 inches in length, though some mills in use and now being erected have slightly larger rollers. The pressure of all these new mills is controlled by hydraulic means. The Krajewski Crushers and the National Shredders are used in several factories in front of the mills, and they are both said to do good work in the preparation of the cane for the rollers.

Clarification of juice by the Deming apparatus is gradually extending, and crystallisation in motion is now attracting the attention of those interested in the introduction of what is best amongst the novelties of sugar-making.

Amongst the advantages claimed for the Deming system by those acquainted with its working are, that it economises from

25 to 33 per cent. over the open system and secures better results, that it is nearly automatic, one man easily operating all its parts, and that the saving in labour often exceeds 10 per cent. on a sum twice greater than the total cost of the system.

Chemical control in the sugar houses is still somewhat neglected, although there are marked indications of a desire on the part of mill managers to have resident chemists to check all losses."

Ceroxylon andicola.—Mr. R. B. White, an old correspondent of Kew, sends the following interesting account of what appears to be a well-marked local variety of this palm :—

MR. R. B. WHITE to ROYAL GARDENS, KEW.

Tulua, Department of Cauca,
Republic of Colombia,
DEAR SIR, December 1st, 1897.

I SEND you by parcel post some seeds of what I believe to be an interesting variety of *Ceroxylon andicola*. This palm, as you know, is found only in the Central Andes. Its inferior limit is 7,000 ft. with a mean temperature of 60°, but it is most abundant at 8,000 to 9,000 ft. with a temperature of 55° to 57°.

The palm of which I send you seed is found in the Western Andes, 60 miles south of Cali, in the valley of Cajamarca on the Pacific watershed. It is most abundant at an elevation of 5,500 ft. in a mean temperature of 67° to 68°. Good sugar-cane grows alongside of it.

The flowers, fruit, &c., are similar to those of *C. andicola*, but the tree is very distinct. It has no base of fasciculated rootlets as *andicola* has, but springs clear from the ground. The stem is slighter and not so tall as *andicola*, and I should say that 150 ft. is the average height. The leaves are 20–25 ft. long, but much slighter and lighter than *andicola*, and there is only just sufficient white scale on the underside of the pinnæ to give them a whitish colour. Whilst the leaf is not fully formed and hardened the pinnæ are joined together at the points by a slender thread, as in some Attaleas and Sabals, and I have not noticed this peculiarity in *andicola*. The wax which coats the stem is as abundant as in *andicola*, but seems different in composition ; it has an agreeable smell when rubbed or burned which the wax of *andicola* has not, and it is more brittle, which would seem to indicate a larger proportion of resin. I send you a small sample, and if you find it to be worth experimenting upon I can send you more. The resinous and fatty matters ought, I think, to be examined separately.

The fact of this palm growing in a warmer climate ought to make its acclimatisation easier, and it may turn out to be more valuable than *andicola*.

I should mention that the farinaceous pulp within the rind covering the seeds is slightly bitter, but the hogs do not mind this and avidly devour the whole fruit, and fatten well upon it.

A palm yields here about 800 lbs. of fruit in two flowerings annually. In other countries it may only flower once, producing,

say, 400 lbs. Being equal to maize for fattening pigs, these 400 lbs are worth $3.20, supposing maize to be worth 80 cents per 100 lbs. The hogs pick up the fallen fruit.

The palms may be climbed as they climb coco palms, and the wax scraped off. Here they cut down the palms, and each one yields from 15 to 25 lbs. of wax.

When mixed with tallow and made into candles the wax of *andicola* gives a bad smell to the smoke, which I do not think would happen with the wax of the Cajamarca palm.

It may be that the prehistoric aborigines acclimatised *andicola* in the Western Cordillera and so produced this variety. If not a new species, a fair name for it would be *Ceroxylon andicola occidentalis*.

I shall hope to hear what you think of this palm.

I remain, &c.

(Signed) ROBERT B. WHITE.

The Director, Royal Gardens, Kew.